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A MANUAL

OF

MEDICAL JURISPRUDENCE.

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OF
MEDICAL JURISPRUDENCE.

BY

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> "Es vergeht kein Tag an dem nicht einige sehr junge Erfahrungen, eine alte Theorie zu Grabe tragen."—SCHWÖRER.

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PREFACE.

THE present Manual may be regarded as the completion of a work, of which one volume was published in the year 1836, under the title of "Elements of Medical Jurisprudence." The scale upon which that work was commenced, rendered it impossible for me to complete it in less than four volumes of a similar size; and I therefore resolved, as a new edition of the first volume was required from the many important additions made to the science during the last seven years, to rearrange the subject, and by an alteration in the type, complete the work in a single volume,—thereby endeavouring to render it a convenient and practical guide to the medical jurist.

MEDICAL JURISPRUDENCE, whereby we are to understand *that science, which teaches the application of every branch of medical knowledge to the purposes of the law*, is now so well known as to render it unnecessary for me to enter into any explanation of its objects. Its claims, as a distinct science, to the attention of the profession rest upon two grounds: 1st, that the subjects of which it treats are of practical importance to society; and 2nd, that they are not included in the other branches of a medical education. How far these positions are borne out by facts, will be best understood by a reference to the contents of this Manual.

The only arrangement which it has appeared to me advisable to follow, has been that of placing the subjects in the order of their importance. Thus POISONING, WOUNDS, and INFANTICIDE, constitute more than three-fourths of those cases which require the aid of a medical jurist in a court of a law. Hence these have been treated at a length commensurate with their importance. The subjects are examined in the form of questions, and those on TOXICOLOGY, more especially in reference to general poisoning, have been framed, with some modifications, on the plan originally proposed by Orfila and Christison. The arrangement of the questions, relative to WOUNDS and INFANTICIDE, has been chiefly derived from an analysis of the medical evidence given on the numerous trials connected with those crimes during the last fourteen years. By this arrangement, it is expected that every point of any practical interest will be brought before the reader. A large number of the cases in this Manual have never before been published. They are entirely derived from modern sources, and it is anticipated that these will be much more serviceable to the practitioner as illustrations of the duty required of him, than those drawn from old and obsolete annals. Some of these cases I have been able to collect by my connexion with Guy's Hospital,—many have been kindly furnished to me by those gentlemen, who, in the course of the last thirteen years, have attended my lectures on Medical Jurisprudence in that institution; and others again I have derived from the quarterly and weekly medical periodicals of England, Scotland, France, and Germany. Where the limits of the subject would not allow me to introduce illustrative cases, ample references have been given, so that the medical or legal student, who requires further information on particular questions, may easily obtain it.

I am not aware that any subject of importance, strictly and practically medico-legal, or likely to require the aid of a general practitioner, has been omitted. No separate chapter has been devoted to medical evidence, but all that it is important for a witness to know will be found at pp. 29 and 284. With respect to FEIGNED DISEASES, the duties of a practitioner rarely go beyond the detection of feigned poisoning, wounds, pregnancy, delivery, and insanity; and an account of these will be found in the chapters on those subjects. The practical points connected with AGE, IDENTITY, and SURVIVORSHIP, as they concern a medical witness, will be found scattered throughout the volume. In almost every case of AGE or IDENTITY, the question is settled by the evidence of non-professional witnesses; and it has therefore seemed to me improper to introduce distinct chapters upon such subjects to the necessary exclusion or abbreviation of other cases which are of much greater practical importance and more frequent occurrence. The chemical processes in the department of toxicology are, for the most part, what I have been in the habit of demonstrating to the medico-legal classes of Guy's Hospital for many years past.

It is unnecessary for me to remark that great responsibility is attached to the duties of a medical witness, and that any member of the profession may find himself involved in this responsibility, from circumstances of a merely accidental nature. When a crime, requiring medical evidence for its elucidation, is perpetrated, the duty of the whole investigation commonly devolves on the practitioner, who lives nearest to the spot: it is therefore virtually upon his knowledge and experience, that the clear proof of the crime and the legal punishment of the offender, must rest. He should remember that this duty lies strictly in developing the medical proofs of the crime; and he must endeavour to lay aside that feeling, which often induces us to see a criminal in every one who happens to be accused:—"*priùs est de crimine quàm de reo inquirendum.*"—(GROTIUS.) I trust that I may not be found to have departed from this maxim in treating the subjects contained in this Manual. While I have endeavoured to bring forward every medical point which would seem to establish a crime, I have not concealed the very numerous objections to which all medical evidence is exposed. On one side, my object has been to establish guilt,—on the other, to vindicate innocence. A man may be wrongly or rightly accused; but it is for a jury to decide this point, and that medical jurist appears to me to lose sight of the true object of the science, who devotes the energies of his mind, in a case otherwise doubtful, to only one side of the question. We ought not to hear, as we have done in recent times, of a medical prosecution and a medical defence. Under such circumstances, a medical jurist can be regarded no longer as the scientific witness of truth, but as the biassed advocate who will spare no effort to extricate the party for whom he appears. He entirely forgets that his evidence should always be given with a view,—not to the acquittal or conviction of a particular individual, but to the vindication of justice, and the due protection of society. He appears for the country, and neither for the Crown nor the prisoner,—at least, however defective the present mode of summoning medical witnesses may be, this is the character which it seems to me he should endeavour to maintain.

It is the necessity for a knowledge of the objections to which medico-legal doctrines are exposed, that gives an apparent want of conclusiveness to the subjects treated. The rules are seemingly overwhelmed with exceptions; and the reader is disposed to think that certainty can never be obtained. A little reflection will, however, show that such must be the nature of every subject, directly or indirectly connected with jurisprudence. Truth is here continually derived from a balance of conflicting evidence, and the exception is often as essential to the ends of justice, as the rule.

Some medical practitioners are disposed to treat medico-legal inquiries with indifference. They are apt to think, that cases are rare; and that they may easily escape any grave responsibility when they occur. I have never known this indifference manifested by one, who had once been summoned as a medical witness to a court of law; and as to the rare occurrence of cases, I may perhaps be permitted to make the following remarks. From some recent Parliamentary returns, it appears that in one year in the United Kingdom, there were twelve hundred and thirteen trials involving questions of murder and manslaughter, either perpetrated or attempted, from POISONING and WOUNDS alone, in every one of which medical evidence was necessary, and in the majority, indispensable to conviction. In two years, there were five hundred and forty-one deaths from poison in England and Wales alone, (see p. 83,) in the greater number of which, medical evidence was absolutely required. This is exclusive of criminal attempts at poisoning not followed by death. I omit all reference to medical evidence in civil cases; because these are comparatively rare, but nevertheless the above facts will show that a practitioner must not too confidently rely upon the chance of escaping duties which may reflect upon him the greatest public honour or disgrace, according to the manner in which they are performed.

3, Cambridge Place, Regent's Park,

Nov. 10th, 1843.

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POISONING.

CHAPTER I.

WHAT IS A POISON?

A POISON is commonly defined to be a substance which when administered in small quantity is capable of acting deleteriously on the body. It is obvious that this definition is too restricted for the purposes of medical jurisprudence. It would, if admitted, exclude a very large class of substances the poisonous properties of which cannot be disputed.

If we examine the list of irritant poisons, we shall find that many of these, more especially the salts of lead, copper, tin, zinc, and antimony, are only poisonous when administered in very large doses:—they have but a very feeble action when taken in small quantity.

Nitre, cream of tartar, and pearlash are capable of acting as poisons, and have destroyed life; but only in those cases where about an ounce of either salt has been exhibited. On the other hand, it is well-known that death has proceeded from the exhibition of a few grains only, of arsenic or corrosive sublimate.

It is not necessary to extend these remarks, or to make further comparisons on the action of different poisons. In a medico-legal view, whether a person dies from the effects of an ounce of nitre, or of five grains of arsenic, is a matter of little importance. Each substance must be regarded as a poison, differing from the other only in its degree of activity and perhaps in its mode of operation. The result is the same; death is caused by the substance taken, and the quantity required to kill cannot therefore be made a ground for distinguishing a poisonous from a non-poisonous substance. If, then, a medical witness is asked,

" What is a poison?" he must beware of adopting this common definition, or of confining the term poison to those substances only, that operate in small doses.

The fact that a poison has been commonly regarded as a substance which produces serious effects when taken in small quantity, has induced many who have adopted this arbitrary view to assert, that certain substances which have actually caused death are not poisons; and this doctrine has been apparently strengthened by the fact, that were not some such distinction adopted, it would be difficult to separate the class of poisons from substances which are reputed inert. In answer to this view, it is perhaps sufficient to show, that there is no good reason for assuming this as the distinguishing character of a poison; for, it is impossible, even among substances universally admitted to be poisonous, to make any division according to the effects produced by the quantity taken. In relation to the quantity required to operate fatally, the difference is not so great between cream of tartar and oxalic acid, as between oxalic acid and strychnia. If we consider nitre and cream of tartar to be poisons, there seems to be no good reason for excluding common salt (the chloride of sodium). Medical practitioners would scarcely be prepared to admit this last-mentioned substance into the class of poisons; but it is to be observed that in a very large dose, it is capable of acting as a powerful irritant, and of inflaming the mucous membrane of the alimentary canal to the same extent, as much smaller doses of other well-known irritants. An instance of common salt having caused death occurred in the north of England in the year 1839. A young lady swallowed, it is supposed, about half a pound of this substance, for the purpose of destroying worms. It was considered to be a harmless substance, according to the common notion; but in the course of about two hours, some alarming symptoms made their appearance, and medical assistance was sent for. She was found to be in a state of general paralysis; and although the stomach-pump and other antidotal means were speedily employed, she died in the course of a few hours. After death there were found the post-mortem changes generally indicative of the effects of a violent irritant on the alimentary passages.

This case is deserving of attention, not merely from its novelty, but from the evidence which it furnishes of the fallacy of the popular doctrine, that what is taken so freely in small quantities, without mischief, may be taken, with equal impunity, in large doses. In a toxicological view, we do not see how the effects of salt in this case are to be distinguished from the action of the sulphate or acetate of copper; nor how, if we agree to call the latter substances poisons, we can consistently refuse this appellation to the former. It may appear to be a violation of common language, to call the chloride of sodium a poison, but assuredly it would be a greater inconsistency, to refuse to consider it as such, merely because it requires to be exhibited in a larger dose than some other irritants.

It is to be observed that this is not a solitary instance of poisoning by salt. Dr. Christison mentions a case which occurred some years since in London, where a man swallowed a pound, and died within twenty-four hours, under all the symptoms of irritant poisoning.

There is another substance commonly reputed to be an innocent medicine; but which in a large dose may destroy life. This is the sulphate of magnesia, or Epsom salts.

A trial took place at the Huntingdon Autumn Assizes, 1842, in which two men were indicted for feloniously killing one Daniel Cox, by administering to him a large quantity of Epsom salts, dissolved in beer. The deceased was an old man and a confirmed drunkard, and he was in the habit of drinking beer to excess. On the day laid in the indictment, the deceased had drunk several pints of beer, which, it was afterwards proved had been drugged with the sulphate of magnesia. He was seized with violent purging, and died within forty-eight hours. On a post-mortem examination, the lining membrane of the alimentary canal was found to be inflamed, and there was no doubt that death was owing to the irritant effects of the salt. One of the prisoners was convicted. The quantity of the substance taken in this case could not be ascertained, but there was reason to suppose that the dose was large.

A case is mentioned by Christison in which a boy ten years old, had two ounces of the sulphate of magnesia administered to him medicinally by his father, as a remedy for worms. The salt was taken partly dissolved in a tea-cupful of water, and very soon after it had been swallowed the boy staggered and became unwell. When seen by a medical man half an hour afterwards, his pulse was imperceptible, his breathing slow and difficult, the whole frame in a state of great debility, and in ten minutes more the child died without any other symptom of note, and particularly without any vomiting. (Treatise on Poisons, 491.) It is remarkable that in this case, there does not appear to have been any purging, and after death no morbid appearance was found in the body. It has been suggested that substances of this kind connect the true poisons with those which are inert in regard to the economy: but they are assuredly to be regarded by the medical jurist as irritant poisons, and as to the dose administered it is of little importance in medicine or in law whether one grain of one substance or one ounce of another substance be taken, provided the fatal effects be clearly traceable to the action of the particular substance on the body. This is the point to which a medical jurist must direct his inquiries.

The sulphate of soda would no doubt act in a similar way. It has been recommended to administer large quantities of these substances, in poisoning by barytes and lead. Thus M. Devergie says, that they should not be given in doses of less than two or three ounces. The irritant properties of these salts in large doses should however be borne in mind. Although the sulphates in such cases are liable to be partially or entirely decomposed, yet it appears to me advisable, that smaller doses should be given dissolved in a large quantity of water.

In Medical Jurisprudence, therefore, we must look to the effects produced by particular substances on the system, and their adequacy to cause death under symptoms of poisoning, rather than to the mere quantities in which they may have been taken.

These remarks on the looseness of the common definition of the term poison have been suggested by the fact that medical men have been severely pressed in cross-examination on trials for certain criminal offences, to state what is strictly a poison, and what is not. We shall see hereafter that in charges of attempted poisoning, or of criminal abortion by the administration of drugs, it is not an indifferent matter for a witness to be able to say what substances are noxious and what are inert; or to show, how some bodies commonly reputed inert, may under certain conditions act deleteriously on the system.

There is another point of view in which this question may require to be considered, namely, What is to be understood by a *deadly* poison? In most indictments for poisoning, it is customary to describe every poison as *deadly*, a form of expression decidedly bad, and calculated to give rise to legal objections. The substance administered might with equal propriety be described as poisonous, or of a destructive nature; but those who draw up indictments are but little informed on such matters, and they can never speak of a poison without describing it as deadly.

The following case occurred on the Norfolk Spring Circuit, 1836.

Two persons were capitally indicted for having feloniously caused to be administered to the prosecutor, a quantity of a certain "*deadly poison*," called sulphate of copper (blue vitriol) with intent to murder him.

It appeared in evidence that all the parties were servants in a farmer's family, and that it was the duty of one of the prisoners to prepare breakfast for the other servants. On the morning of the day laid in the indictment, the prosecutor observed, that the milk which had been prepared for him was very nauseous, and, after having taken a small quantity, he laid it aside. He was soon seized with violent vomiting, but under medical assistance he recovered. The residue of the milk was analysed, and was found to contain sulphate of copper.

In the defence, the counsel for the prisoners contended that they could not be convicted of the crime charged in the indictment, since, according to all medical experience, the sulphate of copper was not a *deadly* poison. The medical witnesses, of whom there were two, were then required to give their opinions, but they differed on the point. One, a surgeon of some practice, considered it to be a deadly poison, although he admitted that so far as his own experience went, he had had no knowledge of its poisonous effects. The other stated that it was not a deadly poison, and that when sold in a shop, the word poison was never attached to the label. The judge considered the case to be one of suspicion rather than of proof, and the prisoners were acquitted.

Although, by this summary disposal of the case, the force of the objection to the indictment was rather evaded than decided, yet the difference of opinion between the two medical witnesses is worthy of remark. The question may be easily raised again, and there ought to be some understanding among practitioners as to the proper signification of the word *deadly* when applied to poisons.

It appears to me that the term *deadly* can be used with respect to those poisons only which may prove speedily fatal in small doses, such as strychnia, morphia, prussic acid, and arsenic, and that it could not with any sort of propriety be applied to such substances as the sulphate of copper. The error essentially lies in the legal wording of the indictment, with which, of course, a medical witness is not concerned. If an objection of this kind is to be held valid, and a question of criminal poisoning to be dismissed on so trivial a point, it is reasonable to expect that greater care should be used in drawing up indictments, as also that medical terms should not be employed by non-medical persons without proper supervision. Otherwise, it is obvious that the ends of justice must be defeated. Differences of opinion among educated medical witnesses are not likely to exist where slight previous reflection has been bestowed upon the subject.

A similar question arose in a trial which took place at Chelmsford some years ago, where the substance administered was copperas or sulphate of iron. A man was charged with having administered this substance to two women, with intent to murder them; and in the indictment it was described as a *deadly* poison. The medical witness stated that it was not, properly speaking, a deadly poison.

This is so far true, that it is rare to meet with a case in which this substance has destroyed life. There is no doubt that green vitriol is capable of acting as an irritant, and as such, if taken in a large dose, and not ejected from the stomach by vomiting, it may produce inflammation of the viscera and death. It is clear, however, that a person who described copperas as a deadly poison, could have had but little acquaintance with the subject of poisons. If any advantage is to be taken by prisoners from such a misapplication of medical words in indictments for this crime, it is only just that the preparation of these instruments should be entrusted to persons possessing some knowledge of legal medicine.

After all, it must strike the reader that an objection of this kind is too trivial to be entertained. It would seem reasonable that the proof of the crime of poisoning should rest either upon the fact of the substance administered being a poison, or of its having the power of operating as such. Whether it be strictly of a deadly nature or not, should be considered a matter entirely subordinate to the main inquiry.

In legal medicine, it is difficult to give such a definition of a poison as shall be entirely free from objection. Perhaps the most comprehensive definition which can be suggested, is this: "A poison is a substance which, when taken internally, is capable of destroying life without acting mechanically on the system."

Under this definition, it might be objected that the whole class of medicines, and numerous substances of an inert nature, would be included. Thus it is well known, that there are many cases on record in which cold water, swallowed in large quantity, and in an excited state of the system, has led to the destruction of life either rapidly by shock, or slowly by inducing gastritis. Any cold liquid, such as iced water, beer, or ice itself, may have an equally fatal effect. The action of water or cold liquids, under these circumstances, cannot be said to be mechanical; it appears to be due to the shock suddenly induced on the nervous system through the lining membrane of the stomach, and yet it would be inconsistent to class these inert liquids among poisons.

In all cases of this description, it appears to me, that we are justified in drawing the following distinction between poisonous and non-poisonous substances. If the deleterious effect does not depend upon the nature of the substance taken, but upon the state of the system at the time at which it is swallowed, the substance cannot be regarded as a poison. All poisonous substances are *per se* deleterious,—the state of the system, setting aside for the present the peculiar effects of idiosyncrasy and habit, has very little influence on their operation. The symptoms may be suspended for a time or slightly modified in their progress, but sooner or later the poison will affect the healthy and diseased, the old and the young, with a uniformity in its effects, not to be easily mistaken. A distinction of this kind cannot, however, be drawn except by a professional man, who has given attention to the subject of toxicology, and therefore it is no matter of surprise that poisoning should have been in more than one instance erroneously imputed, in cases where death has followed the drinking of cold liquids.

In thus giving the medical definition of a poison, it is necessary to observe that the law never regards the manner in which the substance administered, acts. If it be capable of injuring the health of an individual, it is of little consequence, so far as the responsibility of a prisoner is concerned, whether its action on the body be of a mechanical or chemical nature. Thus a substance which simply acts mechanically on the stomach, may, if wilfully administered with intent to injure, involve a person in a criminal charge, as much as if he had administered arsenic, or any of the ordinary poisons. It is then necessary that we should consider what the law means by the act of poisoning. If the substance criminally administered destroy life, whatever may be its nature or mode of operation, the accused is tried on a charge of murder, or manslaughter, and the whole duty of the medical witness consists in showing that the substance taken was the certain cause of death.

If, however, death be not a consequence, then the accused is tried under a particular statute for the attempt to murder by poison. (1 Vict. c. 85, sec. 2.) The words of this statute are very general, and embrace all kinds of substances, whether or not they be popularly or professionally regarded as poisons. Thus it is laid down that:

> "Whosoever shall administer or cause to be taken by any person, any poison or other destructive thing, with intent to commit murder, shall be guilty of felony, and being convicted thereof, shall suffer death."

The same administering with intent, &c. although no bodily injury be effected, is felony, punishable by transportation for life, for fifteen years, or imprisonment for any term not exceeding three years.

Such is the present state of the law of England in respect to attempts at poisoning where death does not take place. While the words of the statute render it unnecessary for a medical witness, in such cases, to give judicially a very close definition of "a poison," they impose upon him a difficulty which he must prepare himself to meet. The substance administered may not be a poison in the medical signification of the term, nor may it be popularly considered as such, and yet, when taken, it may be destructive to life. We have examples of substances of this description in iron filings, powdered glass, pins and needles, and such like bodies, all of which have been administered with the wilful design of injuring, and have on various occasions given rise to criminal charges. In cases of this kind, the legal guilt of a prisoner may often depend on the meaning assigned by a medical witness to the words *destructive thing.* Thus, to take an example,—liquid mercury might be poured down the throat of a young infant, with the deliberate intent to destroy it. A question of a purely medical nature will then arise whether mercury be a destructive thing or not; and the conviction of the prisoner will probably depend on the answer returned by the witnesses. Should a difference of opinion exist, an occurrence by no means unusual in medical evidence, the prisoner will, according to the humane principle of our law, receive the benefit of the doubt. The point which here requires to be considered is, why any difference of opinion should exist among witnesses.

With regard to the case just supposed, it is a general principle in toxicology, that the pure metals are not poisonous; and they are not to be regarded as destructive to life, unless the mechanical form in which they are taken, be such as to injure the viscera with which they may come in contact, leading to inflammation and its consequences. Even where the mechanical form favours the production of these serious results, especially perforation of the intestines, the powers of nature are often exerted in the most extraordinary way, and the individual lives apparently in good health. This has been witnessed in the cases of many who have swallowed knives or pins and needles. The escape of such persons must, however, be regarded as the result of accident. They are always in imminent danger, and they commonly die sooner or later from perforation of the viscera.

Liquid mercury, the substance which we have taken as an illustration, cannot operate deleteriously on the body either chemically or mechanically. It may be taken, and has often been swallowed in very considerable quantities, without perceptibly affecting the health. If a medical witness were not aware of these facts, and did not sufficiently reflect upon the nature of the question addressed to him, he might improperly cause the conviction of an accused party. The intention of the prisoner may have been criminal, but that is a matter unconnected with the duties of a witness:—he is simply required to state whether the means employed to carry out this criminal intention, were such as to be likely to produce danger to life. Similar observations might be made with regard to numerous other substances employed in medicine or the arts, and it is quite obvious that difficulties of this kind can only be properly met by those practitioners who have attended to the subject of toxicology.

It is well known that bodies which are not in their own nature destructive, may become so through indirect causes. Metallic iron is not a poison, nor can it, except under certain circumstances, be regarded as a destructive thing. An angular mass of iron may, however, kill by perforating the viscera; or, if the metal be exhibited in the state of filings, in large doses frequently repeated, then it may become a source of irritation in the stomach, and lead to ulceration and perforation. There will be no difficulty, however, for a practitioner to form an opinion in this and all similar cases.

Among the singular methods resorted to for the purpose of destroying the lives of infants and children, that of causing them to swallow pins or needles in their food is one which claims the attention of medical jurists. This mode of perpetrating murder has been brought to light by the evidence given on several criminal trials, which have taken place of late years in England and on the continent. In cases of this kind, death is commonly to be referred to inflammation: and a practitioner can have no hesitation in designating these bodies, when exhibited to young children, as "destructive things:" they are at all times likely to lead to serious injury, if not to death; nor is it any answer to this view to assert, that they have been often swallowed with impunity. We know that active poisons are sometimes taken without causing death; but this does not alter our opinion of their being substances destructive to life, and likely to give rise to the most serious consequences. A case is reported in the Medical Gazette (vol. xxvi. p. 582) which will show how far the powers of nature are sometimes capable of resisting the effects of these mechanical irritants. Here it appears that two hundred and fifty-four pins and needles were removed from a female aged 23, in whose body the greater number had remained for a period of thirteen years.

That death may ensue from this cause, is made evident by a case of very recent occurrence. In August, 1841, a boy aged eleven years was committed to Newgate on a charge of theft. Shortly after his imprisonment, he swallowed a quantity of pins for a trifling wager. He soon afterwards became extremely ill, and died in the course of a few weeks, evidently from the effects of the mechanical irritant which he had swallowed.

A girl was tried in France in 1838, upon a charge of having endangered the life of an infant aged five weeks, by administering to it pins. The medico-legal investigation of this case was entrusted to M. Ollivier. From the evidence given on that occasion, it appears that in the opinion of M. Ollivier, these mechanical irritants are likely to produce more serious effects in an adult than in an infant; but this view is not based upon any particular facts. He also asserted that pins and needles, when swallowed, were comparatively harmless, and that a fatal termination was the exception to the rule.—(Annales D'Hygiène, t. xxi. 178.)

In regard to the opinion expressed by M. Ollivier of the non-production of serious consequences by these mechanical irritants, it may be observed that there is a sufficient number of fatal cases on record, to justify us in asserting that they are destructive things, and may endanger life.

The following is, in this respect, a case of some interest, since, on a post-mortem examination, death was clearly referrible to the mechanical irritant.

A girl was charged with having caused the death of her child by administering to it pins. Nine days after its birth, a pin was found in its mouth; and in about six days afterwards the child died The mother confessed that she had caused it to swallow pins for the purpose of destroying it. The child had been born prematurely, and was of weakly habit. The abdomen was carefully examined, and the transverse arch of the colon, with the small intestines near it, was in a state of inflammation. On turning over the liver, it was found to be penetrated on its under surface near the gall-bladder by a pin, the head of which could be felt within the duodenum. The liver, pancreas, and intestines were glued together by bands of adhesive matter. On laying open the cavities of the viscera, the head of the pin was found to be near the pylorus. The pin was of a large or coarse kind, about an inch and a half in length; and after traversing the parietes of the duodenum, it had penetrated into the liver for about an inch from before backwards. There were marks of inflammation in the liver, but the other viscera were healthy. Death was undoubtedly due to the inflammation produced by this mechanical irritant.—(Henke Zeitschrift der S. A. 1838.)

It is obvious that the fatal effects thus induced by pins or needles must be in a great measure accidental. It is not from the number of these articles swallowed, nor from the age of the subject, that any just inference can be drawn as to the probability of their proving fatal to life. If it be true, as M. Ollivier asserts, that death is the exception to the rule, it is not the less true, that the life of any individual who has swallowed pins or needles is always in danger until they are discharged. Sometimes, in these cases, life may be suddenly destroyed by hæmorrhage. Mr. Bell has published a case in which a young man aged 18 accidentally swallowed a needle in soup. In the course of ten days, he had several attacks of spitting of blood, and in one of these fits he vomited a large quantity, and expired in a few minutes. On examination, a fine sewing needle was found lying across the œsaphogus, the point of which had penetrated the right common carotid artery, and had led to the fatal hœmorrhage.—(Med. Gaz. xxxi., 694.)

That a medical jurist must be prepared for giving evidence on the effects of mechanical irritants will be proved by the following case, which came to trial on a charge of murder at the Chelmsford Assizes in 1835.

The prisoner, an old woman, was indicted for the murder of her granddaughter, by causing her to swallow some sponge and a piece of wood. It was also suspected that she had administered pins to the child. The deceased was eleven weeks old; and until within a very short period of its death, it had appeared to enjoy very good health. The evidence of the only medical witness examined, was to the following effect. He stated, that on a post-mortem examination of the body of the child, he had found the mucous membrane of the stomach inflamed as well as the liver, and there were adhesions of the peritoneum. The stomach contained a piece of wood, and there were several pieces of sponge in the large intestines. On inspecting the viscera more closely, he discovered a pin imbedded in the substance of the liver, on its convex surface next the stomach. The pin was discoloured by the fluids of the body. The substances which he found in the body, were sufficient to produce inflammation; and it was in his judgment, this inflammation that had caused the death of the child. The witness could give no opinion as to how the pin had penetrated into the liver. On cross-examination, he admitted that the pin might have found its way into the cavity of the abdomen by accident. The wood and sponge might also have been accidentally introduced during the dressing and feeding of the child. It was left to the jury to say, whether the substances found in the viscera, and which by mechanical irritation had led to inflammation and death, had been introduced wilfully or accidentally, and as there was no direct evidence on this point, they acquitted the prisoner.

In this case, the mechanical irritation was probably as much due to the sponge as to the pin. The quantity of sponge found within the intestines was small. It is difficult to conceive how these different substances should have been accidentally swallowed by an infant.

Sponge may be regarded as a mechanical irritant; but little is known concerning its action on a human being. In the Medical Gazette (vol. xxxi. p. 124), two cases are related in which this substance was swallowed by a horse. In one case, it did not appear that the animal suffered any inconvenience; but in the other case, it became alarmingly ill. There can be but little doubt, that where sponge remains lodged in the viscera, it is capable of producing inflammation and death.

Among mechanical irritants, there yet remains to be mentioned one, which was formerly regarded as an active poison, namely, *pounded glass*. Recent observations have satisfactorily shown, that this substance is not a poison. It is liable to inflict injury upon the alimentary canal, just in proportion to the size and sharpness of the fragments; and whenever it is swallowed in a state of coarse powder, it may irritate and excite inflammation of the stomach and bowels.

Glass, in very fine powder, is decidedly alkaline; but it does not possess any of the properties of an alkaline poison:—on the contrary, in that condition, in which its alkalinity is most manifested, it appears to be inert. It is said, that six or seven ounces of this substance have been given to a dog without producing any inconvenience to the animal. A trial for murder occurred in Paris in 1808, in which the accused was charged with having poisoned his wife by administering to her pounded glass. This substance was found in the stomach, and both this organ and the intestines exhibited marks of great irritation. Baudelocque and Chaussier gave their opinion that the glass was not the cause of death. Portal relates an instance of a young man who during a debauch broke a glass between his teeth, and then swallowed some of the fragments. These were afterwards expelled by active vomiting, and he recovered. In an attempt made by an ignorant person some years since to poison a whole family with coarsely powdered bottle-glass mixed with food,—no inconvenience resulted to those who had swallowed a portion of the glass. A case is, however, reported in which it appears highly probable that a child aged eleven months was killed by the administration of this substance. Powdered glass was found in the mucus of the stomach and the lining membrane itself was very vascular.

It is obvious that a substance of this description cannot be easily swallowed by an adult, without his being perfectly aware of it; and the instances in which it has been administered to infants are very few in number. Although I believe the only instance reported of its having acted fatally is in the case of the infant just described; yet a medical jurist cannot hesitate to say that pounded glass is a mechanical irritant, and that the irritation caused by the presence of a large quantity of this substance in the stomach or bowels, might lead to fatal gastritis or enteritis.

Some toxicologists have placed hot liquids, such as *boiling water* or *oil,* in the class of mechanical irritants; but the action of such liquids cannot with propriety be said to be mechanical. They do not act like poisons, although they leave in the body, changes similar to those produced by corrosive poisons. Death from the accidental swallowing of boiling water, is by no means uncommon among young children. According to the observations of Dr. Hall and Mr. Ryland, death is most commonly to be ascribed to inflammation of the fauces and larynx, produced by the contact of the boiling liquid. This inevitably leads to suffocation, unless assistance be at hand. Sometimes, however, inflammation of the stomach is a consequence. A case of this kind occurred a few years since at Guy's Hospital, and on a post-mortem examination, the mucous membrane at the larger end of the stomach was found to be much inflamed. The appearance was very like that produced by the common mineral irritants, although it was more confined to one part of the mucous membrane.

CHAPTER II.

THE MODE OF ACTION OF POISONS. THE CAUSE OF DEATH.

In investigating the phenomena which attend the operation of poisons, we are led to inquire into the mode in which they affect the body and cause death. This inquiry is highly interesting in a physiological and pathological view; but it is not of much importance to a medical jurist. In the generality of cases, all that the law requires to be established by medical evidence is that the substance taken was adequate to cause death. Nevertheless, in a recent case of poisoning by opium, a medical witness was specially examined by the court, as to the mode in which this drug was supposed to cause death; and in other instances, questions of a similar import have been put with respect to other poisons. This is sufficient to justify the introduction of a few remarks on the subject in this place.

Poisons have either a *local* or *remote* action upon the system; and in the greater number of cases, both of these actions are manifested by the same substance.

LOCAL ACTION.—The local action of poisons is most strikingly seen in those substances which are of a corrosive nature such as the mineral acids and alkalies. A chemical change is induced by these agents in the structure of the part with which they come in contact, whether it be on the outside or inside of the body; and should the disorganization produced, be very extensive, death will take place, as in any other case of mechanical lesion to a vital organ. If the individual survive the first effects, and the poison be not neutralized or removed from the stomach, the local irritation produced may give rise to inflammation, with ulceration, gangrene, and their consequences. But the local action of a poison is not always indicated by physical changes in a part. The effect may be confined to the sentient extremities of the nerves only, manifested by the occurrence of paralysis. It is well known that aconite, morphia, and prussic acid, are capable of affecting the nerves, if they remain sufficiently long in contact with a part: and many experiments have proved, that the nerves supplying the hollow viscera through which sensation is not manifested, are equally susceptible of this local action. Opium applied directly to the intestines has been known to put an end to their peristaltic motion; and the same phenomenon was accidentally observed by Addison and Morgan in their experiments with the ticunas poison. From these facts it is inferred, that the alkaloidal poisons act in a similar way upon the stomach, or upon the nervous fibres of the part to which they are applied. The difference between the local action indicated by physical change, and that which is unaccompanied by any such change, is this:—that in general the former being chemical, takes place equally in the dead and the living—the latter in the living subject only.

There are certain poisons, concerning the local action of which some doubt exists among toxicologists. Thus arsenic possesses no corrosive action; it does not chemically destroy a part; and although we might infer from the extensive morbid changes which are observed in the stomach in cases of arsenical poisoning, that it must have a powerfully local action; yet there are many facts which are strongly opposed to the admission of this view. Thus, inflammation of the stomach has been found in cases where the arsenic was applied externally to a wound or an ulcer. Besides, we do not find that the degree of inflammation is in proportion to the quantity of the poison taken; sometimes it is extensive under a small dose, and at others scarcely apparent under a large dose. An examination of the mucous membrane is commonly sufficient to show that arsenic has no local action like the corrosive poisons. Yet it cannot be denied, that it irritates without destroying the delicate lining membrane of the viscera.

In cantharides, we have a substance which acts locally by irritating and inflaming the part to which it is applied, whether this be the stomach or the skin. It neither corrodes the animal substance, nor does it appear to have any paralyzing action on the nerves. The local action of a corrosive poison is often changed by combination. Thus, pure barytes, from its causticity, exerts a chemical action on the stomach and acts as a corrosive; but when combined with carbonic acid, under the form of carbonate of barytes, it acts simply as an irritant.

Hence it would appear poisons may operate locally in three ways:—1. By chemically destroying the part with which they come in contact. 2. By paralyzing the sentient extremities of the nerves. 3. By simply irritating the part, and giving rise to inflammation and its consequences.

REMOTE ACTION.—By this we are to understand that power which most poisons possess of affecting an organ remote from that to which they are applied. The same substance often possesses both a local and remote action: but some poisons affect one organ remotely, and others, another. Cantharides, a poison which has a violent local action as an irritant, to whatever part it may be applied, affects remotely the urinary and generative organs. Morphia, whether applied to a wound or to the mucous membrane of the stomach, affects the brain. Digitalis taken internally affects the heart; strychnia, the spinal marrow. In some cases, this kind of action is more obscure; and the same poisons will affect remote organs differently, according to the form and quantity in which they may have been taken; and, perhaps, according to peculiarity of constitution in the poisoned subject. The mineral acids rarely affect the brain remotely:—the mental faculties, in cases of poisoning by them, commonly continue clear until the last moment of life. Arsenic sometimes affects the heart, which is indicated by syncope:—at other times the brain, which is known by the coma and stupor that occasionally supervene in poisoning by this substance. Oxalic acid has been found by Christison and Coindet, to affect remotely either the heart, the spinal marrow, or the brain, according to the strength of the solution in which it was administered, to animals.

In all cases of poisoning, whether the substance have a local action or not, death must be ascribed to the influence exerted on a remote organ important to life. Most poisons destroy life by affecting the heart, brain, or spinal marrow. The impression produced on either of these important organs, is not always so intense as to kill; for individuals have been known to recover where alarming symptoms from this remote influence had manifested themselves. In some instances, however, the impression produced is such as to annihilate, speedily, the vital functions. Thus large doses of hydrocyanic acid or strychnia, kill with great rapidity, without producing any local changes:—doubtless by the powerful impression which they produce on the brain and spinal marrow. Even where local changes of any extent are met with, as in poisoning by the mineral acids, death is to be ascribed to the fatal impression produced on a remote organ—commonly the heart. Whatever gives rise to similar lesions in the stomach, whether the cause be chemical or mechanical, will operate in like manner. In the action of the mineral acids, the fatal effect is not commonly so rapid as where there has been a destruction of the organ from causes of a mechanical nature. A person has been known to fall dead in a few seconds from a lacerated wound of the stomach produced by a pistol bullet; and there has been no hæmorrhage to account for this rapid death; while in poisoning by sulphuric acid, where the coats of the viscus have been extensively perforated, and the acid has escaped into the abdomen, some hours have elapsed before the individual has died. Thus, then, poisons which have the most extensive local action, kill by affecting remote organs important to life, just like mechanical injuries of similar extent. There may be a difference in the time at which death takes place; but the cause of death is the same, namely—a remote operation by sympathy, otherwise called shock.

Nothing is more common than to hear it said in cases of arsenical poisoning, that the local changes are sufficient to account for death. These changes, which are due to the irritant properties of the poison, should, however, be regarded rather as accompaniments of its action, than as absolutely necessary to explain its fatal effects; although it cannot be denied, that violent inflammation, attended by ulceration or gangrene, may account for death as in cases of severe gastritis produced by any cause whatever. In this and in most other instances, where the substance is simply irritant, death is commonly due to the remote influence of the poison. This view appears probable from the fact, that if the arsenic be removed from the stomach before it has had time to produce any well-marked local changes, the case may nevertheless prove fatal. Again, it is well known, that three or four grains of arsenic, a quantity insufficient to produce any striking local changes, will destroy a person under the usual symptoms of poisoning. The same may be said of corrosive sublimate:—three or four grains of this poison would suffice to kill an adult; and yet from this small quantity the local changes would be barely perceptible.

Thus, then, with regard to poisons generally, it is established that whether they chemically corrode, irritate, or produce no apparent alteration in the part to which they are applied, they destroy life by producing a fatal impression upon a remote vital organ. That death should ever take place in poisoning without any physical changes being produced on the body, is not more wonderful than that it should occur under attacks of tetanus or hydrophobia, in which diseases, as it is well known, no post-mortem appearances are met with to account for their rapidly fatal course.

Two questions will naturally here present themselves for our consideration. 1. In what way is this remote influence of poisons conveyed to the vital organs? and 2. How does it act on the vital organs to destroy life?

With regard to the solution of the first question, there is still great difference of opinion among toxicologists. It may be sufficient to say, that all are agreed that the influence must be conveyed either by the blood-vessels or by the nerves. According to the first view, absorption is necessary to the action of a poison; and according to the second, all that is requisite is, that the poison should come in contact with the nervous filaments of any part of the body. In the last case, some have considered that the influence is conveyed by the cerebro-spinal, and others by the ganglionic, system of nerves. It would be out of place to enter into the respective merits of these theories; it will be merely necessary to state a few of the facts which have been derived from experiments on the subject.

Absorption.—We will first inquire whether poisons enter into the blood; and if so, whether the entrance into that fluid is absolutely necessary to the production of their fatal effects.

It has been long known that certain mineral substances, when taken internally or applied externally to a wound, can be detected in the blood, and some of the secretions of the body. Among these the acetate of lead, sulphate of iron, and muriate of barytes, are said to have been found in the blood; and it is well known that the iodide of potassium can be readily detected in the urine of persons who are taking it medicinally. The following experiment was performed about twelve years since by Mr. Key:—a quantity of ferrocyanate of potash in powder was rubbed into a wound on the inside of the leg of a donkey; and about six hours afterwards the animal was killed. Mr. Key forwarded to me for analysis one portion of blood taken from the femoral vein, another portion from the mesenteric veins, and lastly the contents of the thoracic duct. The ferrocyanate was readily detected in the three specimens, being most abundant in the blood of the femoral vein, and least abundant in the contents of the thoracic duct. From experiments similar to this, it has been inferred that most poisons enter into the circulation.

But an inference of this kind does not rest upon bare analogy. Within the last three years, Orfila has detected arsenic in the blood of persons poisoned by arsenious acid, both during life and after death. It mattered not from what part of the body the blood was taken, arsenic was equally discovered; so that from these and other experiments of the same toxicologist, it would appear that the living or dead body in a case of arsenical poisoning, is for a time penetrated throughout by the poison, and during life it appears to be constantly eliminated by the urine. The fact that arsenic may be detected in the blood of a person who survives its effects is a point which may hereafter become of considerable importance in a medico-legal view. Thus simple venesection may furnish evidence otherwise only satisfactorily obtained by a post-mortem examination of the body; and those cases of the criminal administration of arsenic to the living, which now generally escape the hands of justice, owing to the want of satisfactory chemical proof, may become as clearly established to the satisfaction of a jury, as if the poison had operated fatally, and been found after death in the stomach. Arsenic has also been discovered by Orfila in the viscera and urine of those who have been poisoned by it. In a late case of acute arsenical poisoning, I found traces of arsenic in the liver, on a chemical examination of about seven ounces of that viscus.

Antimony has been detected by Orfila in the urine of persons to whom tartar emetic was administered, and also in the substance of the viscera of animals killed by it. It was not discovered either in the blood or any of the liquids of the body except the urine. Copper was found by Orfila in the substance of the viscera of animals to which the poisonous salts of that metal were given, but not in the blood or secretions. Tiedemann and Gmelin are said to have discovered verdigris in the venous blood of horses poisoned by it; and the same chemists detected the acetate of lead under similar circumstances. In an accident which occurred to a cow not long since, where the animal swallowed a quantity of carbonate of lead mixed for paint, I detected traces of lead in the milk drawn some hours after the poison had been taken.

M. de Kramer of Milan has lately announced that he has detected nitrate of potash in the blood, urine, and fæces of persons to whom that salt was exhibited,—the iodide of potassium in the blood, chyle, and urine,—and iodine in the blood of a kid which had been made to respire the vapour of that substance. In other experiments, he found the chloride of barium,—tartar emetic, and nitrate of silver (?) in the blood and fæces. For the details see Ann. D'Hyg. April 1843, 415.

From an essay lately published by Dr. Percy on poisoning by alcohol, it would appear that that poison enters into the blood, and is conveyed to the brain, in which organ, as well as in the liver, he succeeded in detecting it by the common process of distillation. He also found it in the blood, bile, and urine.

So far for chemical proofs, but in some instances we cannot detect the poison in the blood or fluids, and yet it is clear that it must have entered into them. The nitrate of silver, if we except the somewhat doubtful results recently obtained by M. de Kramer, is a remarkable example of this kind. It is a corrosive poison, and kills by producing an extensive destruction and disorganization of the viscera. Absorption in this case does not appear to be necessary to its poisonous action, yet it is undoubted that when this substance is exhibited in small doses for medicinal purposes, it is conveyed in some form into the circulation,—a fact established by the peculiar discoloration of the skin of the face and hands produced by its long-continued employment. It is impossible to say in what form it is transmitted, since, unless the ordinary chemical affinities are suspended by the powers of life, the nitrate of silver could not as such be circulated with the albumen or salts of the serum. Some other corrosive poisons, such as potash and the mineral acids, having a purely local action, are no doubt capable, when exhibited in a diluted form and in small doses, of entering into the blood. At least with regard to potash, its chemical effects may be soon observed on the urine, although analysis may not detect it either in that fluid or the blood.

The absorption of substances which are commonly supposed to act as poisons independently of that process, might be considered an argument against the necessity for absorption taking place in any case in order that a poison should produce its usual effects on the body. This question will be presently considered; our object has been to show, whatever may be the mode of action, that some poisons find their way into the blood, even when their presence cannot be chemically detected in that fluid.

Such then are the facts which prove that poisons are absorbed. There are many substances of the absorption of which no proof can be offered; but, judging by analogy, it does not seem unfair to infer, that most, if not all, can under certain circumstances enter into the blood.

But is this absorption necessary to their fatal action? In some cases, as in the action of the corrosive poisons, the nitrate of silver, the mineral acids and alkalies, it certainly does not appear to be necessary. In other cases, as in the action of arsenic and alcohol, the question does not admit of so ready an answer. I exclude, for the present, those substances that have not been detected in the blood, such as corrosive sublimate, which, while it acts locally as a corrosive, is most probably at the same time absorbed, because it will destroy life in a dose in which its local effects would be insignificant.

It might be supposed, that if the blood of a poisoned animal were found to be poisonous, the question would be answered in the affirmative. Vernière has shown, by an ingenious experiment, that the venous blood of an animal poisoned by nux vomica, is capable of acting as a poison to another; and it is highly probable that if a very large dose of nux vomica could be given to one animal, and, while labouring under its effects, a sufficient quantity of blood could be taken from it and transfused into the body of another, it would be found that this liquid might act as a poison and cause death. There are, however, insuperable obstacles to the performance of such experiments; because if a large dose of poison be given to the first animal, it may die before a sufficient quantity of blood be transfused from it. If a small quantity of poison be given, or a small quantity of blood be transfused, no inference can be drawn from the results; if a large quantity of blood be transfused, this may cause the death of the animal which loses the blood, without being sufficient to produce fatal effects in the other.

Magendie has adopted the view that all poisons are absorbed, and that the blood is in all cases a solvent for the poison. According to him, they are transmitted to the brain, and destroy life in directly affecting that organ by contact. But even allowing that most poisons are absorbed, it is probable that the action of some is wholly independent of that process. The experiments of Addison and Morgan have also clearly proved that, with one poison at least, (the woorara,) death took place as speedily in those cases where it was prevented from reaching the brain, as in those where it had free access to that organ.

SYMPATHY.—When a poison destroys life without apparently entering into the blood, it is said to act through a shock or impulse transmitted from the sentient extremities of the nerves of the part to which it is applied; and this is the way in which the remote influence of many poisons on vital organs is explained. It is what is termed an action by sympathy.

This view of the action of poisons is founded on the fact that some of these agents produce their effects with too great rapidity to allow of the supposition of absorption being necessary. Thus hydrocyanic acid, strychnia, and other alkaloidal poisons will, in a strong dose, affect an animal in a few seconds. In exhibiting hydrocyanic acid to three young cats, the symptoms of poisoning came on immediately; and death took place, as nearly as could be ascertained, in from five to ten seconds. Alcohol has also been known to produce its effects instantaneously.

In some instances, the effect of these powerful agents on the nerves has been rendered visible, as in the instance cited, of the immediate arrest of the peristaltic motion of the intestines by the contact of tiennas. Although when applied to a wound or introduced into the stomach, there is no apparent change, we cannot doubt, from the rapidity with which the effects ensue, that some impression is produced on the nerves, and transmitted by them to remote organs. The experiments of Addison and Morgan render it probable that the impression is transmitted by the ganglionic, and not by the cerebro-spinal, system of nerves.

An attempt has been made to explain these cases by assuming that the process of absorption is more rapidly carried on, than is commonly supposed; and it has been inferred, because hydrocyanic acid and strychnia have been found by physiological experiments to enter the blood of the part to which they are applied, that this entrance into the circulation, is always necessary to their action. With regard to the first point, Müller states that a poison in solution brought into contact with a wounded surface, may be distributed through the system by absorption in from half a minute to two minutes; but according to the experiments of Mr. Blake, it would appear that a poison may be diffused through the circulation in so short a period as nine seconds, and the latter experimentalist further asserts that an interval of always more than nine seconds elapses between the introduction of a poison into the capillaries or veins and the appearance of its first effects. Admitting that the absorption of poisons takes place so rapidly as is here stated, it is a pure question of fact as to the time at which their effects begin to manifest themselves. (Ed. M. and S. J. lvi. 414.) In experimenting upon cats with prussic acid, I have seen the effects produced so rapidly, that there was no sensible interval between the application of the poison to the tongue, and the production of its effects, and death took place in a period of time shorter than that which is here stated to be necessary for the appearance of the first symptoms of poisoning. In Freeman's case (see post, poisoning by hydrocyanic acid) it was stated by the medical witnesses, that a dog died in three seconds from the effects of a large dose of hydrocyanic acid. Unless, then, it be rendered probable that a poison may be circulated through the body in a much shorter period of time than nine seconds, we must admit that these agents do occasionally produce their effects by what is termed sympathy.

Some poisons appear to act only by absorption, and others independently of that process. Thus, to take two animal poisons, *that* of the rattle-snake kills instantly, or within a few seconds;—certainly within a period of time so short as not easily to allow of the hypothesis of the poison being diffused by absorption. On the other hand, the poison of hydrophobia by its long incubation appears to act by absorption, for we can hardly imagine if it acted sympathetically on the nerves by contact, that its operation should be often suspended for so many months. It seems to me that if we are to take the rapid effect of a poison as favourable to the supposition of its action by sympathy, we must take its very slow operation as favourable to the hypothesis that absorption is a state necessary to its action on the system. This would explain why symptoms have not appeared where the bitten part has been early excised.

It appears probable that even with the same poison, absorption may be sometimes necessary to its action, and at other times not. Alcohol presents this anomaly. A man has been known to fall lifeless instantaneously from a powerful dose of alcohol; in other instances, some minutes have elapsed before the symptoms of poisoning have manifested themselves. Dr. Percy has observed this difference in the effects on animals poisoned by this liquid, but in the greater number of cases, an interval of a few minutes passed before a total loss of sensibility supervened. Hence he infers, that absorption is generally necessary for the action of alcohol. He has not found that the evacuation of the contents of the stomach by the stomach-pump, removed the symptoms,—a fact in favour of its acting by absorption. The same has been observed with respect to arsenic; the symptoms have not abated, and persons have died where the poison had been completely removed from the stomach, partly by vomiting, and partly by mechanical means.

It has been supposed that the circumstance of a solid poison being more energetic and speedy in its action, when in a state of solution, was in favour of the view that it acted always by absorption. This, however, is erroneous: it proves nothing either way; for it is obvious that in this finely divided state it is not only better fitted for absorption, but it is also better adapted to act on the sentient extremities of the nerves.

Thus then, I think, we may draw these conclusions: 1. That the remote influence of poisons is sometimes conveyed through the medium of the blood. 2. That it may be conveyed by contact with the sentient extremities of nerves, probably of the ganglionic system. 3. That some poisons may act in both ways at different times.

Cause of Death.—When the poison operates rapidly without entering the blood, death must be ascribed to the shock impressed on the general nervous system, from the contact of the poison with the nerves of the living tissues. The nature of the impression thus produced can no more be determined than the nature of thought or sensation. There is no greater difficulty in conceiving that such an impression may be excited by a poison, than that a slight mechanical injury in a remote part of the body may cause an attack of tetanus. (Addison and Morgan on Poisonous Agents, p. 64.) The fact that certain poisons do enter the blood, and act through that fluid, does not bring us any nearer to an explanation of the direct cause of death. One hypothesis assumes that the organ remotely affected is poisoned by the blood which contains the substance dissolved. Reasons have been already assigned for rejecting this view with respect to those substances that powerfully affect the brain. This doctrine has been lately revived by Liebig in a new form. He considers that the alkaloidal poison, morphia, for example, may be chemically converted into brain by the subtraction of some elements, and the addition of others; the quality of the cerebral matter may be thereby altered, and rendered unfitted to support vital energy. (Anl. Chem. 183.) It may be sufficient to say, that there do not appear to be any grounds for admitting such an extraordinary hypothesis; and that the poison operates with too great rapidity to allow of the supposition of such a physical change of structure taking place.

Anglada supposes that a poison absorbed may act directly on the blood by destroying its vitality. Addison and Morgan believe that the poison, when in the blood, acts upon the sentient extremities of the nerves of the lining membrane of the vessels, and that thereby a fatal impression is produced sympathetically on the general nervous system. This last view is supported by many experiments and observations.

Those who advocate the theory of absorption in opposition to that of sympathy, suppose that they thereby account for the cause of death; but nothing can be more unfounded. Admitting that every poison entered into the blood, it would yet remain to be explained how it operated when there, to destroy life. Whether the poison be in the midst of the blood in an external wound, or circulating in an artery or vein, it kills, and the last mentioned theory has at least the advantage of affording an analogical explanation of the mode in which the fatal impression is conveyed, in the two cases.

It is possible that the nervous fibres on the inner coats of the blood-vessels may be more susceptible of the influence of poison, than the nerves elsewhere. This would explain why the activity of some poisons is great in proportion to the absorbing power of the surfaces, to which they are applied; and also why in the case of the poison of hydrophobia, no symptoms are manifested until it has been taken into the current of the circulation. It appears probable from the long incubation which it undergoes, that the hydrophobic poison does not act like strychnia and hydrocyanic acid, by producing an impression on the extremities of the nerves of the wounded part.

In concluding these remarks on the action of poisons, it will be necessary to say a few words on the influence of *habit* and *idiosyncrasy*.

HABIT, it is well-known, diminishes the effect of certain poisons:—thus it is that opium, when frequently taken by a person, loses its effect after a time, and requires to be administered in a much larger dose. Indeed, confirmed opium eaters have been enabled to take at once, a quantity of the drug which would have infallibly killed them, had they commenced with it in the first instance. Dr. Christison has remarked that this influence of habit is chiefly confined to poisons derived from the organic kingdom; and I quite agree with him, in thinking that the stories related of arsenic-eaters, and corrosive-sublimate eaters, are not to be credited. There is no proof that any human being has ever accustomed himself, by habit, to take these substances in doses that would prove poisonous to the generality of adults. The only form in which I have known the question of habit to be raised in medical jurisprudence is this: whether while the more prominent effects of the poison are thereby diminished, the insidious or latent effects on the constitution are at the same time counteracted. The answer is of some importance in relation to the subject of life-insurance:—for the concealment of the practice of opium-eating by an insured party has already given rise to an action, in which medical evidence on this subject was rendered necessary. As a general principle, we must admit that habit cannot altogether counteract these insidious effects of poisons; but that the practice of taking them, is liable to give rise to disease or impair the constitution.

IDIOSYNCRASY differs from habit:—it does not, like this last, diminish the effect of a poison: for it is not found that any particular state of body is a safeguard against the effects of these powerful agents. Some constitutions are observed to be much more affected than others by certain poisons:—thus opium, arsenic, and mercury, are substances of this description, and this difference in their effects, is ascribed to idiosyncrasy. Again, certain substances generally reputed harmless, and indeed, used as articles of food, are observed to affect some persons like poisons. This is the case with pork and certain kinds of shellfish. There may be nothing poisonous in the food itself; but it acts as a poison in particular constitutions:—whether from its being in these cases a poison *per se*, or rendered so during the process of digestion, it is difficult to say. The subject of idiosyncrasy is of great importance in a medico-legal view, when symptoms resembling those of poisoning follow a meal on a particular kind of food. In such a case, without a knowledge of this peculiar condition, we might hastily attribute effects to poison, which were really due to another cause.

CHAPTER III.

ON THE CLASSIFICATION OF POISONS.

POISONS were formerly arranged in three classes, according to the kingdom from which they were obtained; and thus we had mineral, animal, and vegetable poisons. The inutility of such a classification must be apparent when it is considered, that we do not, by adopting it, acquire any knowledge of the properties of the poison or its action on the economy. This is now seldom followed by toxicologists: and if applied at all, it is only in a form subordinate to a physiological classification, so as to allow poisons to be arranged in analogous groups convenient for description.

Poisons may be divided into three classes, according to their mode of action on the system, namely, IRRITANTS, NARCOTICS, and NARCOTICO-IRRITANTS. This classification is a modification of that originally proposed by Orfila; and is almost universally adopted by toxicologists.

The IRRITANTS are possessed of these common characters. When taken in ordinary doses, they occasion speedily violent vomiting and purging. These symptoms are either accompanied or followed by intense pain in the abdomen. The peculiar effects of the poison are manifested chiefly on the stomach and intestines, which, as their name implies, they irritate and inflame. Many substances belonging to this class of poisons, possess corrosive properties, such as the strong mineral acids, caustic alkalies, corrosive sublimate, and others. These, in the act of swallowing, are commonly accompanied by an acrid or burning taste, extending from the mouth down the œsophagus to the stomach. Some irritants do not possess any corrosive action,—of which we have examples in arsenic, the poisonous salts of barytes, carbonate of lead, cantharides, &c., and these are often called pure irritants. They exert no chemical action on the tissues with which they come in contact; they simply irritate and inflame them.

There is this difference between CORROSIVE and IRRITANT poisons. Under the action of corrosive poisons, the symptoms are commonly manifested immediately, because mere contact produces disorganization of a part, usually indicated by some well-marked symptoms. In the action of the purely irritant poisons, the symptoms are generally more slowly manifested, seldom showing themselves until at least half an hour has elapsed from the time of swallowing the substance. Of course, there are exceptions to this remark; for sometimes irritants act speedily, though seldom with the rapidity of corrosive poisons. It is important, in a practical view, to distinguish whether in an unknown case, the poison which a person requiring immediate treatment, may have swallowed be irritant or corrosive. This may be commonly determined by the answer to the question, as to the time at which the symptoms appeared after the suspected poison was taken. In this way we may often easily distinguish between a case of poisoning from arsenic and one from corrosive sublimate. There is also another point which may be noticed. As the corrosion is due to a decided chemical action, so an examination of the mouth and fauces may enable us to determine the nature of the poison swallowed.

It has been already stated that there are many irritant poisons which have no corrosive properties; and therefore never act as corrosives: but it must be remembered that every corrosive may act as an irritant. Thus the action of corrosive sublimate is that of an irritant poison, as, while it destroys some parts of the coats of the stomach and intestines, it irritates and inflames others. So again most corrosive poisons may lose their corrosive properties by dilution with water, and then they act simply as irritants. This is the case with the mineral acids.

In some instances, it is not easy to say whether an irritant poison possesses or not corrosive properties. Thus oxalic acid acts immediately, and blanches the mucous membrance of the mouth and fauces, but I have never met with any decided marks of corrosion produced by it in the stomach or viscera.

Irritant poisons, for the most part, belong to the mineral kingdom; and they may be divided into the non-metallic and metallic irritants. There are a few derived from the animal and vegetable kingdom; but these are not very often employed criminally. Some of the gases likewise belong to the class of irritant poisons.

Narcotic poisons have their operation confined to the brain and spinal marrow. Either immediately or some time after the poison has been swallowed, the patient suffers from cephalalgia, vertigo, paralysis, coma, and in some instances tetanus. They have no acrid burning taste like the irritants; and they very rarely give rise to vomiting or diarrhea. When these symptoms follow the ingestion of the poison into the stomach, the effect may be ascribed either to the quantity in which the poison has been taken, and the mechanical distension of the stomach thereby produced, or to the poison being combined with some irritating substance, such as alcohol. The pure narcotics are not found to irritate or inflame the viscera.

Notwithstanding the well-defined boundary thus apparently existing between these two classes of poisons, it must not be supposed that each class of bodies will always act in the manner indicated. Some irritants have been observed to affect the brain or the spinal marrow remotely. This is the case with oxalic acid and arsenic. Both of these common poisons have in some instances given rise to symptoms closely resembling those of narcotic poisoning; namely, coma, paralysis, and tetanic convulsions. Thus, then, we must not allow ourselves to be deceived with the idea that the symptoms are always clearly indicative of the kind of poison taken.

The narcotic poisons are few in number, and belong to the vegetable kingdom. Some of the poisonous gases possess a narcotic action.

Narcotico-Irritants.—Poisons belonging to this class have, as the name implies, a compound action. They are all derived from the vegetable kingdom. At variable periods after being swallowed, they give rise to vomiting and diarrhea like irritants; and sooner or later produce stupor, coma, paralysis, and convulsions, owing to their effect on the brain and spinal marrow. They possess the property, like irritants, of irritating and inflaming the alimentary canal. As familiar examples we may point to nux vomica, monkshood, and poisonous mushrooms. This class of poisons is very numerous, embracing a large variety of well-known vegetable substances; but they rarely form a subject of difficulty to a medical practitioner. The fact of the symptoms occurring after a meal at which some suspicious vegetables may have been eaten, coupled with the nature of the symptoms themselves, will commonly indicate the class to which the poison belongs. Some narcotico-irritants have a hot acrid taste, such as the aconite or monkshood.

I here subjoin tables of the more important poisons, with the properties of which it is necessary for a medical jurist to be acquainted. Poisons are divided into three classes. 1. Irritants. 2. Narcotics, and 3. Narcotico-Irritants. The class of Irritants may be thus subdivided:—

1. IRRITANTS.
- MINERAL.
  - NON-METALLIC.
  - METALLIC.
- VEGETABLE.
- ANIMAL.

CLASS 1.

1. NON-METALLIC IRRITANT POISONS.

Sulphuric acid. Sulphate of Indigo. Nitric acid. Muriatic acid. Nitromuriatic acid. Nitrosulphuric acid. Oxalic acid.* Binoxalate of potash. Potash and its carbonates. Soda and its carbonates. Ammonia and its carbonate. Iodide of potassium. Sulphurets of potassium and sodium. Nitrate of potash. Bitartrate of potash. Sulphate of potash. Alum. Barytes and its salts.

2. METALLIC IRRITANT POISONS.

Arsenic. Arsenite of potash. Arsenic acid. Orpiment. Corrosive sublimate. Calomel. White precipitate. Red oxide of mercury. Turbith mineral. Vermilion. Cyanide of mercury. Nitrates of mercury. Lead and its salts. Copper and its salts. Tartarized antimony. Butter of antimony. Chlorides of tin. Salts of zinc. Nitrate of silver. Sulphate of iron. Muriate of iron. Subnitrate of bismuth. Bichromate of potash.

3. VEGETABLE IRRITANT POISONS.

Aloes. Colocynth. Gamboge. Jalap. Scammony. Savin. Croton oil. Castor-oil seeds. Berries of the yew. Cayenne pepper. Oil of tar.

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* Oxalic acid and the binoxalate of potash, which really belong to the vegetable kingdom, are placed among the non-metallic mineral irritants from the analogy which they bear to these poisons in their effects.

4. ANIMAL IRRITANT POISONS.

Cantharides. Poisonous articles of food.

CLASS 2.

NARCOTIC POISONS.

Hyoscyamus. Lactuca. Solanum. Opium, and its preparations. Morphia, and its salts. Hydrocyanic acid. Oil of bitter almonds, Laurel water. Cyanide of potassium.

CLASS 3.

NARCOTICO-IRRITANT POISONS.

Nux Vomica. Strychnia. Colchicum. Veratria. White hellebore. Digitalis. Conium. Cicuta. Æthusa cynapium. Œnanthe crocata. Datura stramonium. Aconitum napellus. Atropa belladonna. Nicotiana tabacum. Cocculus indicus. Fungi. Camphor. Alcohol.

The selection here made has been chiefly confined to those bodies which have either caused death or given rise to alarming accidents.

CHAPTER IV.

ON THE RULES TO BE OBSERVED IN INVESTIGATING A CASE OF POISONING.

WHEN a practitioner is called to a case of poisoning, it is above all things necessary that he should know to what points he ought to give his attention. It is very proper that every effort should be made by him to save life where the individual is still living: but while engaged in one duty, it is also in his power to perform another, supposing the case to be one of suspected criminal poisoning, namely, to note down many circumstances which may tend to detect the perpetrator of the crime. There is no person so well fitted to observe these points as a medical man; but it unfortunately happens, that many facts important as evidence, are often overlooked. The necessity for observing and recording them, is not perhaps generally known.

The following appear to me to be the principal points which demand the attention of a medical jurist in all cases of suspected poisoning:—
1. With respect to

SYMPTOMS.

1. The time of their occurrence,—their nature.
2. The exact period at which they were observed to take place after a meal, or after food or medicine had been taken.
3. The order of their occurrence.
4. Whether there was any remission or intermission in their progress.

or, whether they continued becoming more and more aggravated until death.

5. Whether the patient had laboured under any previous illness.

6. Whether the symptoms were observed to recur more violently after a particular meal or after taking any particular kind of food or medicine.

7. Whether the patient has vomited :—the vomited matters, if any, (especially those first ejected,) to be procured :—their colour noted,—as well as their quantity.

8. If none be procurable, and the vomiting have taken place on the dress, furniture, or floor of the room,—then a portion of the clothing, sheet, or carpet, may be cut out and reserved for analysis :—if the vomiting have occurred on a deal floor, a portion of the wood may be scraped or cut out :—or if on a stone pavement, then a clean piece of rag or sponge soaked in distilled water may be used to remove any traces of the poison.

Some years since, an animal was poisoned by arsenic. None of the poison could be detected in the stomach, but it was easily found in a portion of deal floor, rendered humid by the liquid matters which the animal bad vomited during the night.

9. Endeavour to ascertain the probable nature of the food or medicine last taken.

10. Ascertain the nature of *all* the different articles of food used at a meal.

11. Any suspected articles of food, as well as the vomited matters, to be sealed up in a proper vessel and reserved for analysis.

12. Note down in their own words, all explanations voluntarily made by parties present, or who are supposed to be concerned in the suspected poisoning.

13. Whether more than one person partook of the food or medicine: —if so, whether all these persons were affected, and how.

14. Whether the same kind of food or medicine had been taken before by the patient or other persons without ill effects following.

In the event of the death of the patient, it will be necessary for a practitioner to note down—

15. The *exact time* of death, and thus determine how long a period the person has survived after having been first attacked with the symptoms.

16. Observe the attitude and position of the body.

17. Observe the state of the dress.

18. Observe all surrounding objects. Any bottles, paper packets, weapons, or spilled liquids lying about, should be collected and preserved.

19. Collect any vomited matters near the deceased. Observe whether vomiting has taken place in the recumbent position or not. If the person have vomited in the erect or sitting posture, the front of the dress will commonly be found covered with the vomited matters.

In the event of a post-mortem examination being ordered by a coroner—

20. Note the external appearances of the body, whether the surface be livid or pallid.

21. Note the state of countenance.

22. Note all marks of violence on the person or discomposure of the dress,—marks of blood, &c.

23. Observe the presence or absence of warmth or coldness in the legs, arms, abdomen, mouth, or axillæ.

24. The presence of rigidity or cadaverous spasm in the body.

To give any value to the two last-mentioned characters, it is necessary for the practitioner to observe the nature of the floor on which the body is lying, whether it be clothed or naked, young or old, fat or emaciated. All these conditions create a difference, in respect to the cooling of the body and the access of rigidity.

25. If found dead, when was the deceased last seen living or known to have been alive?

26. Note all circumstances leading to a suspicion of suicide or murder.

Inspection of the Body.

27. Observe the state of the abdominal viscera.

28. If the stomach and intestines be found inflamed, the seat of inflammation should be exactly specified; also all marks of ulceration, effusion of blood, corrosion, or perforation.

29. The contents of the stomach should be collected in a clean vessel:—their colour, odour, and nature specified.

30. The contents of the duodenum should be separately collected.

31. Observe the state of the large intestines, especially the rectum.

32. The state of the larynx, fauces, and œsophagus, whether there be in these parts any marks of inflammation or corrosion.

33. The state of the thoracic viscera:—all morbid changes noted.

34. The state of the brain.

Such are the points to which, in the greater number of cases of suspected poisoning, a medical jurist should attend. By means of these data, noted according to the particular case to which they are adapted, he will in general be enabled, without difficulty, to determine the probable time of death, the probable cause of death, and the actual means by which death was brought about. He may thereby have it in his power also to point out the dish that may have contained the poison, if the case be one of poisoning; and to throw some light upon any disputed question of suicide or murder in relation to the deceased. Many cases of poisoning are obscure, owing to these points not having been attended to in the first instance.

It is necessary to observe, that all legal authorities rigorously insist upon proof being adduced of the identity of the vomited matters or other liquids taken from the body of a deceased person, when poisoning is suspected. Supposing that during the post-mortem examination, the stomach and viscera are removed from the body, they should never be placed on any surface or in any vessel until we have first ascertained that the surface or vessel is perfectly *clean.* If this point be not attended to, it will be in the power of the counsel for the prisoner to raise a doubt in the minds of the jury, as to whether the poisonous substance might not have been accidentally present in the vessel used. This may be regarded as a very remote presumption ; but nevertheless, it is upon objections of this kind, that acquittals follow in spite of the strongest presumptions of guilt. This is a question for which every medical witness should be prepared, whether he be giving his evidence at a coroner's inquest, or in a court of law. Many might feel disposed to regard matters of this kind as involving unnecessary nicety and care ; but if they be neglected, it is possible that a case may be at once stopped, so that any care bestowed upon the chemical analysis by the practitioner, will thus have been thrown away.

Evidence of the presence of poison in the contents of a stomach was once rejected in a court of law, because they had been hastily thrown into a jar borrowed from a neighbouring grocer's shop ; and it could not be satisfactorily proved that the jar was clean and entirely free from traces of poison (in which the grocer dealt) when used for this purpose. Where the life of a human being is at stake, as in a charge of murder by poisoning, the slightest doubt is always very properly interpreted in favour of a prisoner.

Not only must clean vessels be used for receiving any liquid destined for subsequent chemical analysis ; but care must be taken by the practitioner that the identity of the substance is preserved, or the most correct analysis afterwards made, will be inadmissible as evidence. The suspected substance, when once placed in the hands of a practitioner, should never be let out of his sight or custody. It should be kept sealed under his private seal, and locked up while in his possession. If he has once let it out of his hands, and allowed it to pass through the hands of several other persons, then he complicates the evidence for the prosecution, by rendering it indispensable for these parties to state under what circumstances it was placed, while in their possession. The exposure of a suspected substance on a table, or in a closet or room, where many have access, may be fatal to its identity ; for the chemical evidence, the most important branch in a criminal investigation, will probably be altogether rejected by the court.

A few years ago, a case was tried on the Norfolk circuit, in which the analysis of the matters vomited by a person poisoned by arsenic, was not admitted as evidence against the prisoner, because the practitioner had left them in the keeping of two ignorant women ; and these women had allowed the vessel containing the suspected liquid (which was proved to contain arsenic) exposed in a room open to the access of many persons.

In another case, tried at the Old Bailey sessions in 1835, the analysis of some suspected liquids was not allowed in evidence ; because the practitioner had sent them up to town by a carrier, to be examined by a London chemist, he living at some distance in the country, and being unwilling to take upon himself the responsibility of analysing them. If closely sealed by a private seal, and this be observed by the receiver to be unbroken, before he proceeds to the analysis—this mode of transmission, will not probably be objected to.

It has already been recommended as a rule in these criminal investigations, that a practitioner should make notes of what he observes in regard to symptoms, post-mortem appearances, and the results of a chemical analysis. From the common forms of law in this country, an individual charged with the crime of poisoning may remain imprisoned, if at a distance from the metropolis, for a period of six or seven months before he is brought to trial. It is obvious, however clear the whole of the circumstances may at the time appear to the examiner, that it will require more than ordinary powers of memory to retain for so long a period, a distinct recollection of all the facts of the case. If he be unprovided with notes, and his memory be defective, then the case will turn in favour of the prisoner, for he will be the party to benefit by the neglect of the witness. In adopting the plan here recommended, such a result may be easily prevented.

It may be remarked, that the law relative to the admissibility of notes or memoranda in evidence, is very strict and is rigorously insisted on by the judges. In order to render such notes or memoranda admissible, it is indispensably necessary that they should be taken on the spot at the time the observations are made, or as soon afterwards as practicable. It is not necessary to their admissibility as evidence, that the observations should be written down by the practitioner himself, provided they are made under his immediate inspection at the time or at his suggestion, and are soon afterwards looked over and corrected by him. Thus, whenever, at a trial, a medical witness produces notes for reference during his examination, the question is invariably put to him as to when the notes were made. Their admissibility depends upon his answer.

Many examples might here be cited of the rejection of notes, made by medical witnesses, owing to a non-observance of these points. On the trial of Sir A. Gordon Kinloch at Edinburgh, for the murder of his brother, the surgeon was about to give his evidence respecting the wound of which the deceased had died, from notes made some time after the event, when he was stopped by the judge, who explained to him the law on the subject. The reason why the law so rigorously excludes the admission of memoranda in evidence, made at a distance of time, appears to be this : it prevents the possibility of all fraud or collusion on the part of the witnesses, either to favour or to injure the prisoner ; for a connected story might, it is presumed, by such means be so made up at a distance of time, as to defy the ingenuity of counsel on either side to make out the deceit.

The notes used by a witness, should be original and not a copy of notes made by another. A copy of notes, except under very peculiar circumstances, is not admissible as evidence.

There is another rule of law with respect to the use of notes or memoranda in evidence, which is not perhaps so generally known to medical practitioners; but it is essential that it should be observed. The notes may have been fairly made on the spot in the manner required by law; but when a witness is about to refer to them, he will probably be asked whether he is using them for the purpose of refreshing his memory, or whether he is about to speak only from what is written on the paper, without having any precise recollection on the subject. If he is referring to them for some fact which he has altogether forgotten, then the notes are pro tanto inadmissible as evidence; for it has been held by our judges, that notes can only be used in evidence for the purpose of refreshing the memory on a fact *indistinctly remembered:* they are not permitted to be used for the purpose of reviving impressions entirely forgotten. The most eminent legal writers lay it down, that if there be any single point in the notes, which the witness does not recollect, except that he finds it there written, such point is not evidence. Notes are only allowed to assist recollection, not to convey information.

On a late trial for poisoning, the medical witness, after having detailed the action of some tests, which he had employed in the detection of the poison, referred to his notes before giving the results of other experiments. Upon being asked when the notes were made, he answered satisfactorily by stating, that they were taken at the time of the observations. The counsel then asked the witness, whether he used the notes to refresh his memory, or whether he had forgotten the subject, and was about to speak only from what was written on the paper. The witness said, that his memory was bad; that some time had elapsed, and he had entirely forgotten the results of these experiments. It was then objected that the results could not be given in evidence, since the witness could only speak to the facts from the memorandum which he held in his hand. The objection was admitted by the judge, and the evidence from the analysis was rejected.

The reason for a rigorous adherence to this rule of law is not very apparent. In applying it to medical evidence, it must often operate in such a way, as to give an undue advantage to a criminal. Many witnesses who are summoned to give evidence in courts of law, are not much accustomed to the analysis of poisons; and probably may never have performed the usual experiments, until that particular case occurred to draw their attention to the subject. It is well known to practised analysts, that numerous tests are required to show what a suspected substance is, as well as what it is not;—that the action of these tests is attended with results not easily remembered: and it can be no imputation upon those who are less practised in toxicology, that they should not be able to retain for many months together, the whole of the results of such experiments. We might suppose that the making of a record at the time would be sufficient to render the evidence admissible; nor does it appear how the adoption of such a rule could ever injure a really innocent person.

From the rejection of notes on this ground in the case above quoted, it would seem that good medical evidence, to be available in a court of law, must in many cases depend upon the accidental possession of an excellent memory by the witness. But many men, equally well informed and fitted to act as witnesses, are not equally endowed with this faculty. If justice cannot be safely administered without enforcing such a rule, then it follows, that only those persons who have powerful memories should be selected as witnesses. But it by no means follows, that with an excellent memory there would be that mental capacity which renders a man best fitted for observing those medical facts from which good evidence must always be drawn.

These remarks on the taking of notes, and the method of using them in a court of law, have here been made in reference especially to cases of criminal poisoning; since they are, perhaps, more frequently required in these, than in other medico-legal cases. It will be understood, however, that they apply with equal force to every medico-legal investigation in which the practitioner may be concerned.

CHAPTER V.

ON THE EVIDENCE OF POISONING IN THE LIVING SUBJECT.

THIS inquiry becomes necessary in every case, where a person is charged with having administered poison with intent to murder; but from the effects of which, the patient ultimately recovers. A knowledge of the symptoms produced during life, is also an important part of evidence, in those cases in which the poison proves fatal. At present, however, we will suppose the case to have been that poison has been taken and the patient survives.

Most toxicological writers have laid down certain characters by which it is said symptoms of poisoning may be distinguished from those of disease.

1. IN POISONING, THE SYMPTOMS APPEAR SUDDENLY, WHILE THE INDIVIDUAL IS IN HEALTH.

It is the common character of most poisons, when taken in the large doses in which they are usually administered with criminal intent, to produce serious symptoms either immediately or within a very short period after they have been swallowed. Their operation, under such circumstances, cannot be suspended, and then manifest itself after an indefinite interval; although this was formerly a matter of universal belief, and gave rise to many absurd accounts of what was termed slow poisoning. It is very true, that these powerful agents, given at intervals in small doses, do not cause those striking symptoms upon which a practitioner commonly relies as evidence of poisoning. They may then produce disorder, but of so slight a nature, as scarcely to excite suspicion. Again, there are what are called accumulative poisons, substances which, in small divided doses, produce scarcely any perceptible effect on the system; but which appear to accumulate in the body, and at some unexpected time, their power is manifested with sudden and violent energy. To these forms of poisoning, which it is extremely rare to meet with on criminal charges, the characters about to be described are not applicable.

When poison is criminally administered, it is almost always in such doses as to cause the symptoms to appear *suddenly* and to run their course with great rapidity. The symptoms of poisoning by prussic acid, oxalic acid, or strychnia, appear immediately, or within a very few minutes after the poison is swallowed; while those from arsenic and other irritants, and, indeed, from all poisons generally, are manifested in from half an hour to an hour. It is rare that the appearance of the symptoms is protracted for two hours, except under certain peculiar states of the system. It is said, that some narcotico-irritant poisons, such as the poisonous mushrooms, may remain in the stomach twelve or twenty-four hours without giving rise to symptoms; and this is also affirmed to be the case of some animal irritants, such as decayed meat; but with regard to the first point, it has been shown by Dr. Peddie, that mushrooms may produce symptoms in half an hour; and a case has fallen under my own observation, where the symptoms from noxious food came on within as short a time after the meal, as is commonly observed in irritant poisoning by mineral substances.

It is necessary to remark, that the symptoms produced by some of the most common poisons, are apt to be retarded under certain conditions of the system. When an irritant poison is taken on a full stomach, the symptoms do not commonly appear so speedily, as when the stomach is empty. So again, it is stated by Dr. Christison from cases which have fallen under his notice, that *sleep* retards the action of arsenic, and the same may hold with other irritants. Thus, if the patient should happen to fall asleep soon after swallowing the poison, it may not produce the usual symptoms until four or five hours afterwards, or the occurrence of these may be even longer protracted. This is supposed to be owing to the general state of insensibility of the body, and the depressed condition of the nervous system during sleep.

Intoxication has been considered to retard the operation of opium. Observations of this kind must, of course, be accidental; and there is scarcely a sufficient number of cases reported of narcotic poisoning under these circumstances, to justify a decided opinion on the point.

It was observed of a person, who had swallowed a strong dose of opium, while partially intoxicated, that the symptoms were some hours before they were manifested.

Dr. Christison remarks, what is no doubt the fact, that a *diseased* state of the body may render a person comparatively insusceptible of the action of some poisons. In dysentery and tetanus, a person will take, without being materially affected, a quantity of opium sufficient to kill an adult in average health. Mania, cholera, hysteria, and delirium tremens, are also diseases in which large doses of opium may be borne. The effect of these diseases, as well as of habit, either in retarding the appearance of symptoms, or in blunting the operation of the poison, it is not difficult to appreciate; and they are cases which can present no practical difficulty to a medical jurist.

On the other hand, in certain diseased states of the system, there is an increased susceptibility to the action of poison. Thus in those persons who have a tendency to apoplexy, a small dose of opium may act more quickly and prove fatal. In a person labouring under inflammation of the stomach or bowels, there would be an increased susceptibility to the action of arsenic or other irritants. Indeed it may be safely affirmed, that wherever the body is much debilitated by disease, poisons acquire greater virulence of action. These facts are of some importance in relation to those cases where the party who has taken the poison is already in a diseased or exhausted state. Thus, then, there are but few exceptions to the rule laid down, that the symptoms of poisoning are liable to appear suddenly; and that in most cases they are commonly manifested within an hour.

Then again, it is said, symptoms of poisoning appear in a person while in a state of *perfect health,* without any apparent cause. This rule is, of course, open to numerous exceptions, because the person on whose life the attempt is made, may be actually labouring under disease; and under these circumstances the symptoms of poisoning are so obscure as often to disarm all suspicion. In the case of Mrs. Smith, who was poisoned at Bristol by orpiment in 1835, it was the fact of the deceased having laboured under general illness for some time before death, that prevented any suspicion from being fixed on the prisoner Burdock, who attended her as a nurse. When poison is exhibited in medicine, a practitioner is very liable to be deceived, especially if the disease under which the party is labouring be of an acute nature, and attended by symptoms of disorder in the alimentary canal. Several cases of poisoning have occurred within the last few years, where arsenic was criminally substituted for medicine, and given to the parties while labouring under a disorder of the bowels.

Thus, then, it may be said with respect to this criterion, that where in a previously healthy person symptoms resembling those of poison occur suddenly and without any assignable cause, such as disease or indiscretion in diet, to account for them, there is strong reason to suspect that poison has been administered. When the party is already labouring under disease, we must be especially watchful on the occurrence of any sudden change in the character or violence of the symptoms, unless such change can be easily accounted for on common and well-known medical principles. In most cases of criminal poisoning, we meet with alarming symptoms without any obvious or sufficient cause to explain them. The practitioner is of course aware that there are certain diseases which are liable to occur suddenly in healthy people, the exact cause of which may not be at first sight apparent; therefore this criterion is only one out of many on which a medical opinion should be founded.

Some have said that the symptoms of poisoning are characterized by a *regularity* of increase, or by becoming more and more aggravated as the case advances; but this is a weak criterion. In the operation of most of the active irritants, there are often remissions, and occasionally intermissions of pain, so as to give rise to a false hope of recovery. The character of the symptoms is sometimes suddenly changed; vomiting may cease, and may be succeeded by coma. While then, on the one hand, such a case might, by trusting to this criterion, be regarded as one rather of disease than poisoning; there are, on the other, certain diseases which are very rapid and violent in their progress, and these upon the same grounds, might be mistaken for cases of poisoning.

2. In poisoning, the symptoms appear soon after a meal, or soon after some kind of food or medicine has been taken.

This is by far the most important character of poisoning in the living body. It has been already observed, that most poisons begin to operate within about an hour after they have been swallowed; and although there are some few exceptions to this remark, yet they occur in cases easily to be appreciated by the practitioner. Thus, then, it follows, that, supposing the symptoms under which a person is labouring, to depend on poison, the substance has most probably been swallowed either in food or medicine, from half an hour to an hour previously.

It must be observed, however, that cases of poisoning may occur without the poison being introduced by the mouth. Poisonous substances have been thrown up the rectum in the form of enemata, and the application of many of these bodies to a wounded or ulcerated surface, would give rise to the usual alarming symptoms and endanger life. Such cases of diabolical villany are, it is true, rarely heard of; but nevertheless the certainty that they have occurred where their occurrence could hardly have been anticipated, shows that in a suspicious case, a practitioner should not deny the fact of poisoning, merely because it is proved that the patient could not have taken the poison in the usual way—by deglutition. (See pòst, Sulphuric Acid.)

Let us suppose, however, the circumstances to have been such that these secret means of destruction could not have been resorted to, and that the poison is one of those most commonly selected by a murderer, such as arsenic, oxalic acid, or corrosive sublimate, then we may expect that this character of poisoning will be made evident to us, and that something must have been swallowed by the patient shortly before these alarming symptoms appeared. By observations closely made, it may be in our power to connect the appearance of the symptoms with a particular article of food, and thus indirectly lead to the detection of the criminal.

Supposing that many hours have passed, since food or medicine was taken by the patient, without any effect ensuing; then it becomes very probable that the symptoms are due to some other cause, and not to poison.

The time of the occurrence of the symptoms in relation to a particular meal, is then a fact of especial importance in forming an opinion when poisoning is suspected, as the following cases will show.

The Crown Prince of Sweden, who died in 1812, was considered by many to have been killed by poison. The prince, it appears, was reviewing some troops, when he was observed to fall suddenly from his horse, and he died half an hour afterwards. His physician, Dr. Rossi, was accused of having administered poison to him, and was obliged for his own security to quit the country. It is obvious, however, from an examination of the particulars of the case, that had this sudden attack been due to poison, it could only have been from one of the most active narcotics, given to him but a short time before he fell from his horse. But it was ascertained that the prince had taken neither solid nor liquid of any kind for at least *four hours* previously to his death. The allegation of poisoning was thus disproved, for no poison operating with symptoms like those under which the prince had died could have had its effects suspended for four hours. The cause of death was apoplexy.

The following case is also of some interest. A middle-aged man retired to bed one afternoon about two o'clock much fatigued. In about a quarter of an hour, he was found by one of his workman, gasping, rolling his eyes, and quite insensible; he died a few minutes afterwards. As he had lived unhappily with his wife, it was suspected that she had poisoned him, and the body was therefore examined. The only morbid appearance met with was a considerable tuberculation of the septum and parietes of the ventricles of the heart. This was probably the cause of death: had there been any doubt on the point, the circumstances attending the man's death would at least have shown that it was impossible he could have died from poison. The deceased had taken nothing since his breakfast at nine o'clock No poison, but one of the most active narcotics in a large dose, given but a short time before the attack, could have caused death in a quarter of an hour. These active poisons cannot have their effects suspended for *five hours.* It was, therefore, clear, without resorting to a chemical analysis of the contents of the stomach, that the deceased could not have died from poison.—(Christison.)

In either of these cases, had the symptoms speedily followed the meal, there would have been some obscurity.

By bearing in mind these facts, regarding the period at which the more common poisons begin to produce their effects, it may often be in our power to determine summarily whether the case be one of poisoning or not. In several instances which have been brought to Guy's Hospital, where narcotic poison was suspected to have been the cause of comatose symptoms and rapid death, there was no difficulty in deciding against the suspicion of poisoning, merely from observing the circumstances under which the attack took place. Facts of this kind may sometimes serve to establish the innocence of an accused party, and at others to point out the real criminal. In the next case, the medical question was not so much as to the particular meal at which the poison was taken, but as to the time at which symptoms usually come on after a poison has been swallowed.

A woman aged sixty-five, accused her husband, an old man of seventy, of having attempted to poison her. Tho woman was passionate, ill-tempered, eccentric in her habits, and subject to occasional attacks of hysteria. She handed to the authorities a vessel containing arsenic in coarse powder; and some food which she stated had been prepared for her by the prisoner. On analysis, the food was found to contain a large quantity of arsenic. The husband was immediately committed to prison. The wife left her bed, and was apparently quite well; and so she remained for eight days afterwards, no symptoms of poisoning having manifested themselves about her. She was then seized with a fit of mania, and was guilty of many extravagant acts. She died the following day, i. e. nine days after she had accused her husband of having administered arsenic to her in her food. On a post-mortem examination, it was evident she had died from the effects of arsenic. This poison was found in large quantity in the alimentary canal; and there were the usual morbid changes in the stomach and intestines.

The husband denied that he had administered poison to the deceased. The denial, however, would have availed him but little, had it not been for the careful medico-legal investigation of the whole case, made by the medical witnesses.

As the husband had been confined in prison eight days before the death of his wife, he could not have committed the crime imputed to him, unless he had administered the arsenic previous to his imprisonment. His guilt, therefore, rested upon the medical question, whether a large quantity of arsenic could be taken by a person and remain dormant in the system, without producing any of its usual effects for the long period of eight days. The witnesses very properly answered the question in the negative, and the husband was immediately discharged.—(Annales D'Hygiéne, 1836, 2, 391.)

While the prisoner was with his wife, she did not suffer from the symptoms of poisoning, nor was there any proof that he had administered poison. When, however, he was so situated that he could not possibly have been accessory to its administration, she died from its effects. It was fortunate for the accused that he was thrown into prison, and that the case fell into the hands of persons versed in the subject of legal medicine.

The following singular case is related by Alison :—

Jean Aitkin, or Humphreys, was tried at the Aberdeen September Circuit, 1830, for the murder of her husband, by pouring sulphuric acid down his throat as he lay asleep in bed. The parties frequently quarrelled, and were both addicted to habits of intoxication. On the night in question, some friends had passed the evening with them drinking. They went away about twelvo o'clock at night, and soon after this the deceased was seen asleep in bed. The only persons in the house at this time were the prisoner and a servant-maid, and the street door was locked so that no other person could have access. The prisoner left the servant's room on her stocking-soles, a thing unusual for her, and when she returned in about twenty minutes, she told the servant that her husband was roaring mad with drink. The girl, upon going to him, found him lying upon his back, declaring he was all roasting. The prisoner at first showed an unwillingness to send for a medical man, but at length did so. When the deceased left the guests at twelve, there were only two glasses on the table in the room; but when the neighbours came in after the alarm, there were *three*, and the third was proved to have come from a room above stairs, of which the prisoner had the key. This glass contained, it was supposed, sulphuric acid. In the room where the deceased was lying there was a vial which had contained sulphuric acid, but it was then nearly empty. The deceased lived two days, but never could give any further account of the matter than that he went to sleep quite well, and awoke "all roasting," and had suffered the utmost agony ever since. He evidently died from the effects of sulphuric acid, large quantities of which were detected on his shirt, on the blanket and bedcover, and a little on the prisoner's bedgown and handkerchief; but not a trace of the poison could be discovered in the stomach or intestines of the deceased. —(Alison, Criminal Law of Scotland, p. 75.)—For an able medico-legal analysis of this case by Dr. Christison, see Medical Gazette, vol. viii. p. 77.

The defence pleaded that the deceased had voluntarily taken the poison and committed suicide; but the only time at which he could by any possibility have taken it was when he was drinking with his friends; for immemediately after they left he went to bed, and was seen asleep; and, according to his own account, he awoke suddenly with the pain, and other symptoms produced by this poison. It was impossible that he could have swallowed the acid while drinking with his friends; for the symptoms of the corrosives come on suddenly, and cannot be suspended; therefore the poison must have been poured down his throat while he was sleeping, and as the house was at that time fastened up, this act could only have been perpetrated by the prisoner or the maid-servant. The circumstances above mentioned, clearly showed that the prisoner was the guilty party. It will be observed that all suspicion of suicide, as well as of murder on the part of the persons with whom the deceased had been drinking, was entirely removed, by attention being paid to this well-marked character of the corrosive poisons.

When symptoms resembling those of poisoning follow the ingestion of food or medicine, there is always great room for suspicion; but caution should be observed in such cases, since the most extraordinary coincidences sometimes present themselves. In the celebrated case of Sir Theodosius Boughton, who was poisoned by his brother-in-law, Donellan, in 1781, the fact of alarming symptoms coming on in two minutes after the deceased had swallowed what was supposed to be a simple medicinal draught, became the most important evidence against the prisoner. There is no doubt that laurel water had been substituted for the medicine by the prisoner.

I may here remark, that the practice of substituting poisonous mixtures for medicinal draughts or powders, is by no means unusual, although it might be supposed to indicate a degree of refinement and knowledge not commonly to be found among the lower class of criminals. Medical practitioners are thus apt to be imposed upon, and the following case will serve as a caution. It is related by one of our present judges, Mr. Baron Alderson. An apothecary prepared a draught, into which another person put poison, intending thereby to destroy the life of the patient for whom the medicine was prescribed. The patient, not liking the taste of the draught, and thinking that there was something suspicious about it, sent it back to the apothecary, who, knowing the ingredients of which he had composed it, and wishing to prove to his patient that he had done nothing wrong, drank it himself and died. In this case, he was the unconscious agent of his own death ; and although the draught was intended for another, the party who poisoned it, was held guilty of murder. This case contains a serious warning to medical witnesses. It is not very unusual on trials for poisoning, when the poison is conveyed through medicine, to find a medical witness offering to swallow his own draughts in a court of law, in order to furnish to the court and jury a convincing practical illustration of the innocence of the medicine. I need hardly observe that an exhibition of this kind is never required of a medical witness. The court will receive his deposition, without compelling him to swallow his own medicine, even supposing it not to have been secretly poisoned. If any doubt be raised of the innocent properties of the draught, a chemical analysis of its contents will be far more satisfactory, and attended with no kind of risk to the practitioner.

On the other hand, the occurrence of symptoms something resembling those produced by poison, soon after food or medicine has been taken, may be a pure coincidence. In such a case, poison is always suspected by the vulgar ; and it will be the duty of a medical jurist to guard against the encouragement of such a suspicion, until he has strong grounds to believe it to be well-founded. No public retractation or apology can ever make amends for the injury which may in this way be inflicted on the reputation of another ; for those who hear the accusation, may never hear the defence. In all such cases, a practitioner may not be able to avoid *forming* a suspicion, but it is always in his power to avoid *expressing* it, or giving it publicity.

When death is not a consequence, it is difficult to clear up such cases, except by the aid of a chemical analysis ; but this, as we know, is not always applicable. When death ensues, the real cause is usually apparent, and the suspicion of poisoning is often removed by a post-mortem examination.

The fatal symptoms produced by perforation of the stomach, which so closely resemble those of arsenical poisoning, almost always attack an individual soon after a meal. When they occur some hours after, there is less likelihood of confounding them with arsenic. A few years ago, Mr. Hilton, of Guy's Hospital, and myself, had to examine a case of this description. The diagnosis was in a great measure aided by the fact, that the violent symptoms did not appear until about three hours after a meal. An instance occurred within my knowledge, where an aged lady took three grains of a white powder, prescribed for her by her medical attendant. In about ten minutes afterwards, she was seized with coma, and died in the course of an hour. The medicine which she took, was sulphate of quinine. In such a case it might have been most plausibly said,—morphia or some other poisonous alkaloid had been swallowed ; but the circumstances were well known : death was due to apoplexy. In another instance, a woman, aged 37, rose in the morning in her usual health, with the exception of having a slight headache, and immediately after taking breakfast, was attacked with violent vomiting, which continued for half an hour, when she fell down and died suddenly. Here again there was room for suspecting poison, owing to the time of the occurrence of symptoms, but it was proved that the woman had died of disease of the brain. Many more such cases might be reported ; but these will show that all inferences of poisoning under such circumstances, should be drawn with caution.

The following case, taken from the Medical Gazette, is of some interest in relation to the question which we are here considering.

A gentleman, suffering from what were supposed to be rheumatic pains, applied to an eminent London practitioner for advice. He prescribed for him draughts containing iodide of potassium in the proportion of six to eight grains for each dose. The draughts were prepared by the medical attendant, who administered one to the patient—the latter being in his usual health. He had scarcely swallowed it, when he complained of its being too strong, and declared that he was poisoned. A person present tasted a portion of the liquid, and said it had a very strong taste. The medical attendant put the other draughts in his pocket, saying he would dilute them, and left the house. In about half an hour the patient felt extremely ill. Two other medical men were sent for, but before they could arrive, probably an hour and a half had elapsed, and they found the patient dead. It is not stated under what symptoms deceased laboured ; but it is loosely said that these created a strong suspicion of poisoning. The medical attendant who administered the draught was examined before the coroner, but nothing was elicited as to the cause of death. The remaining draughts were not ordered to be analysed, nor was any post-mortem examination of the body made. One medical witness was asked whether eight grains of iodide of potassium, or even twice that quantity, would be sufficient to cause death. He replied in the negative, and the jury returned a verdict of "Died by the visitation of God."

The investigation of this case seems to have been so disgracefully conducted, that it is impossible to speculate upon what could have been the cause of death, whether poison or disease. The principal reason for suspecting poison was, that the symptoms came on soon after the taking of the medicine ; but this, as is well-known, is not in itself evidence of poisoning. For any thing that appears in the report, the deceased may have been struck with fatal disease of the heart or brain, about the time of taking the medicine, and the symptoms preceding death may have been due to a mere coincidence.

3. IN POISONING WHEN SEVERAL PARTAKE AT THE SAME TIME OF THE SAME FOOD OR MEDICINE (MIXED WITH POISON) ALL SUFFER FROM SIMILAR SYMPTOMS.

This character of poisoning cannot always be procured ; but it furnishes good evidence of the fact when it exists. Thus, supposing after a meal made by several persons from the same dish, only one suffers, the suspicion of poisoning is considerably weakened. The poisoned article of food may be detected by observing whether those who suffer under symptoms of poisoning have partaken of one particular solid or liquid in common. In a case of accidental poisoning at a dinner-party, a friend of mine observed that those who suffered from the symptoms had taken port wine only: the bottle was examined, and found to be a saturated solution of arsenic in wine.

In general, considerable reliance may be placed upon this character, because it is very improbable that any common cause of disease should suddenly attack with violent and alarming symptoms, many healthy persons at the same time, and within a short period after having partaken of food together. We must beware of supposing that where poison is really present, all will be attacked with precisely similar symptoms; because, as we have seen, there are many causes which may modify them. In general, that person who has partaken most freely of the poisoned dish will suffer most severely, but even this does not always follow. There is a well-known case recorded by Bonnet, where among several persons who partook of a dish poisoned with arsenic, those who had eaten little and did not vomit, speedily died; while those, on the other hand, who had partaken largely of the dish, and had in consequence vomited freely, recovered.

It was just now remarked, that there is no disease likely to attack several healthy persons at the same time, and in the same manner. This is undoubtedly true, *as a general principle,* but the following case will show that mistakes may occasionally arise even under these circumstances. It occurred in London during the prevalence of the malignant cholera in the year 1832.

> Four of the members of a family, living in a state of great domestic unhappiness, sat down to dinner in apparently good health; some time after the meal, the father, mother, and daughter, were suddenly seized with violent vomiting and purging. The stools were tinged with blood, while the blueness of the skin, observed in cases of malignant cholera, was wanting. Two of the parties died. The son, who was known to have borne ill-will against his father and mother, and who suffered no symptoms on this occasion, was accused of having poisoned them. A strict investigation took place before the coroner; but it was clearly shown by the medical attendant, that the deceased persons had really died of the malignant cholera, and there was no reason whatever to suspect that any poison had been administered to them.

In this instance, it will be perceived that symptoms resembling those of irritant poisoning appeared suddenly in several individuals in perfect health, and shortly after a meal. We hereby learn that the utility of any rules for investigating cases of poisoning depends entirely on the judgment and discretion with which they are applied to particular cases.

It is well to bear in mind, in conducting these inquiries, that symptoms resembling those produced by irritant poisons may be sometimes due to the description of food which may have been taken at the meal. Besides flesh rendered unwholesome from disease and decay, there are certain kinds of shell-fish, as well as pork, bacon, sausages, cheese, and bread, which, under certain circumstances, may give rise to formidable symptoms, and even death. In such a case, all the foregoing characters of poisoning are brought out; and, indeed, the case may be regarded as one of poisoning by an animal or vegetable irritant. The diagnosis is difficult, and great ambiguity frequently arises, from the fact that not more than one or two individuals may be affected, who have frequently before partaken of the same kind of food without any particular inconvenience. (See pôst, Animal Irritants.)

4. THE NATURE OF THE SYMPTOMS.

In cases of poisoning, the symptoms are commonly well marked, and have a peculiar character; while those of disease are less certain and more likely to create embarrassment. Owing to this, it happens that in practice, disease is much more liable to be mistaken for poisoning, than poisoning for disease.

An account of the symptoms produced by the different classes of poisons will be found in Chapter III. (antè, p. 22.) It will, therefore, now only be necessary to enumerate on the one hand those diseases, the symptoms of which might be mistaken for irritant poisoning, and on the other those which might be mistaken for narcotic poisoning.

The diseases, the symptoms of which resemble those produced by *irritant* poisons, are cholera, gastritis, enteritis, peritonitis, perforation of the stomach or intestines, strangulated hernia, colic, and hæmatemesis.

CHOLERA.—It is necesssary here to distinguish the common English cholera from the Asiatic or malignant form of the disease. In the ASIATIC CHOLERA there is usually sudden and extreme prostration of strength; the surface of the body is very cold, and sometimes has a dark livid or leaden hue, especially observed in the skin of the hands and feet; the breath is cold as it issues from the mouth; the matters discharged from the bowels are very copious, they resemble rice-water with flakes of coagulated mucus floating in them. There is the most intense thirst, and the patient will drink large quantities of cold water. The symptoms of poisoning by arsenic and other irritants are wholly different from these, if we except perhaps the intense thirst which is present in both cases.

The common ENGLISH CHOLERA, as it occurs in summer and autumn, closely resembles arsenical poisoning in its symptoms. Thus, an attack often comes on in a healthy subject in about half an hour after a meal. It is accompanied by vomiting and purging, and by violent pain in the abdomen, continuing until death where the case terminates fatally.

Many acquittals on criminal charges have taken place from the great difficulty which exists in distinguishing this form of cholera from arsenical poisoning; and, in truth, it may be observed, that if in any case medical evidence rested upon symptoms alone, it would be scarcely possible, in some instances, to draw such a clear distinction between the symptoms of this disease and those of poisoning, as the law would deem absolutely necessary for conviction on a criminal charge.

The rules recommended for forming a diagnosis, as they are laid down by the best writers on toxicology, do not appear to be very satisfactory. Perhaps the following may be taken as a statement of the most striking differences. In irritant poisoning the evacuations are often tinged with blood; in cholera they are not tinged with blood, but commonly deeply coloured by bile. In irritant poisoning, these evacuated liquids will sooner or later yield traces of poison when analysed. In cholera this is of course not the case. The attack of cholera is commonly dependent on some irregularity of diet, and appears chiefly in summer and autumn. Irritant poisoning may occur at any season. Persons do not often die from an attack of English cholera; and when the disease does prove fatal, it is commonly after three or four days from its commencement. In irritant (arsenical) poisoning, death is a common result within twenty-four hours, when the symptoms produced by the poison are such as to have resembled those of cholera, i. e. poisoning in its most acute form. In irritant poisoning, the symptoms usually come on in about half an hour or an hour after a meal; and although cholera may commence its attack about the same period, yet, supposing several persons to have partaken of the food, all will suffer more or less if it be really a case of poisoning,—not, if it be a case of cholera. It would be at least something very unusual, that several healthy persons should be attacked by cholera at the same time, unless the attack was owing to some improper kind of food used at the meal. Lastly, an analysis of the food may serve to determine whether irritant poison was or was not the cause of the symptoms.

Of all irritant poisons, arsenic comes the nearest to cholera in the character of the symptoms. It is right to bear in mind, however, that a case of arsenical poisoning is often accompanied by special symptoms, which are met with neither in cholera nor in any disease resembling it. Thus in persons who have taken arsenic and survived the first effects of the poison,—the conjunctivæ of the eyes often become inflamed,—there is also great irritation of the skin, followed by a peculiar herpetic eruption—and sometimes paralysis and coma appear among the symptoms. In cholera, nothing of the kind is witnessed; hence we have in these occasional peculiarities, means for assisting us in our diagnosis.

Further, when the person dies, a post-mortem examination, with an analysis of the contents of the stomach, will often remove any doubts that may have previously existed on the real nature of the case.

Gastritis, Enteritis, Peritonitis.—These diseases do not commonly occur without some obvious cause; indeed, the two first must be regarded as the direct results of irritant poisoning. Thus arsenic and other irritants, when they prove fatal, commonly give rise to inflammation of the stomach and bowels. In all cases where these diseases present themselves, the object of the practitioner is therefore to determine the cause of the inflammation, whether it be due to natural causes or the action of an irritant poison. The diagnosis will chiefly rest, 1. Upon the time of the occurrence of the symptoms after a meal. 2. The order of their occurrence. 3. The obstinate constipation of the bowels, which is observed in gastritis and enteritis, as contrasted with the violent vomiting and purging met with in irritant poisoning. 4. The presence of fever in these diseases. 4. The history of the case so clearly explains its nature, that we seldom hear of these diseases being mistaken for irritant poisoning. The same observations apply to peritonitis, in which disease there is also constipation, and but little vomiting.

PERFORATION OF THE STOMACH AND INTESTINES.—The symptoms attending perforation of the stomach, in some respects resemble those of irritant poisoning. They often occur suddenly to a healthy person after a meal;—but as this disease is invariably fatal, and is immediately recognised on a post-mortem examination, it is unnecessary to make any observations on the means of diagnosis.

STRANGULATED HERNIA.—It is difficult to suppose that this disease should ever be confounded with irritant poisoning. The seat of pain, with an examination of the part, would at once show the cause to which the symptoms were due.

COLIC.—This disease can only be confounded with one variety of irritant poisoning, namely, that induced by the salts of lead. But it is to be observed, that the poisonous salts of lead are very rarely used criminally, and when they are taken in sufficiently large doses to kill rapidly, the symptoms resembling colic are mixed up with those of irritant poisoning; so as to render it impossible for a practitioner to refer them to that disease alone.

HÆMATEMESIS.—In this disease, there is neither pain nor diarrhea; and there is a copious discharge of blood by vomiting. These characters show that it cannot be easily mistaken for irritant poisoning.

We may now proceed to speak of the diseases which have symptoms resembling those induced by *narcotic* poisons. They are apoplexy, epilepsy, diseases of the brain, diseases of the heart, distension of the stomach. Indeed, it may be remarked, that every condition of the body in which life is liable to be suddenly destroyed may be mistaken for narcotic poisoning. The various causes of sudden death are therefore required to be especially studied by a medical jurist. These are not very numerous, andare principally confined to diseases affecting the brain and the heart. There is another point to be attended to, namely, that those fatal diseases only of these important organs, are likely to be confounded with this form of poisoning, the existence of which has not been previously suspected or announced by the usual attendant symptoms.

APOPLEXY.—Narcotic poisons, of which we may take opium as the type, actually seem to produce this diseased condition of the brain. The distinction of apoplexy dependent on disease, from that kind of apoplexy induced by poison, is extremely difficult unless we can obtain a full history of the case. The following circumstances may be remembered in our diagnosis. 1. Apoplexy, as a disease, is sometimes preceded by warning symptoms before the fatal attack comes on. In poisoning, such symptoms would be wanting unless the poison were administered to a person who had already been threatened with apoplexy. 2. Apoplexy, as a disease, does not commonly attack persons under the age of thirty. We shall presently see that there are exceptions to this character. Poisoning may be witnessed in a person at any age. 3. The relation between the time of the attack, and the time at which food or medicine was last taken. Thus if the comatose symptoms do not come on until five or six hours after some liquid or solid has been swallowed, they are much more likely to depend on apoplexy from disease, than on poison. This is a most important character; but its occurrence is of course purely accidental, for it is by no means unusual that an attack of apoplexy should speedily follow a meal made by a previously healthy person. However, cases have already been related, which show that this may be sometimes usefully employed to distinguish disease from poisoning, (antè, p. 35.) 4. In apoplexy from disease, it is usually observed that coma is at once induced;—but in poisoning, coma comes on slowly, and is generally preceded by vertigo and stupor. 5. The discovery of poison in the food taken or in the contents of the stomach:—this would at once establish the fact of poisoning. 6. The discovery of the appearances in the brain indicative of apoplexy, such as effusion of blood. This would negative, cæteris paribus, the presumption of poisoning.

It is to be observed, that in all cases of disease simulating narcotic poisoning, the disease is assumed to prove fatal:—hence there is always the opportunity of searching for the two last-mentioned characters. We do not hear of apoplexy from which a person recovers, ever being mistaken for a case of poisoning by opium.

In reference to the age at which apoplexy may make its attack, it may be remarked that healthy girls of the respective ages of sixteen and twenty-two, have died suddenly from this disease. There had been no warning symptoms whatever.

In January, 1839, a young gentleman aged twenty-two years, retired to his bed-room in good health. Shortly afterwards, a servant entered the room, and found him lying on the floor dead. On a post-mortem examination it was found, that one of the vessels of the brain had become ruptured, and that a large quantity of blood had been effused on the surface. There was no doubt that this was a case of apoplexy in a young man who had suffered from no warning symptoms. It turned out on inquiry, that the father and mother of the deceased had both died suddenly from the same disease.

In the following case, the suspicion of poisoning was actually raised and was only removed by a proper medico-legal examination.

In September, 1838, a young healthy female, while sitting with her parents taking her supper, suddenly fell back in her chair in a state of insensibility. Medical assistance was called in, but she died in about eleven hours without recovering her consciousness. The parents were accused by the neighbours of having administered poison to the deceased at her supper: but the medical attendant, on making an examination of the body, clearly showed that death was caused by an effusion of blood on the brain, from the rupture of a diseased blood-vessel. Apoplexy being very unusual in the young, was a fact which rather tended to strengthen the suspicion of poisoning in this case; although it is obvious that there is no common poison which would produce immediate insensibility except hydrocyanic acid; and when taken in so large a dose as to produce this sudden and violent effect, the probability is, that the patient would die in a few minutes. No poison was discovered in the body: death was undoubtedly caused by apoplexy.

A remarkable case, involving the question—whether death was caused by prussic acid or apoplexy, has just been decided by the senate of Chambèry (April, 1843). I allude to that of M. Pralet, (Ann. D'Hyg. 26, 399, 29, 103, 474), which appears to have excited as much attention on the continent, as the case of Sir T. Boughton, in England. Several medical witnesses deposed that the deceased had died from prussic acid, administered to him by M. L'Heritier, the accused. Orfila was required to examine the medical evidence, and found it extremely defective. The inferences drawn from the application of the chemical tests were highly improper; and the results were essentially negative. Had it not been for the interference of Orfila, it is most probable that the accused would have been convicted, more from the strong medical opinions against him, than from the medical facts of the case. The witnesses appear to have acted on the principle, that the whole of their duty consisted in rendering the charge of poisoning probable; whereas, we shall hereafter see that no person can be convicted of this crime on mere probability: the fact of poisoning must be made reasonably certain, either by medical or moral evidence, or by both combined.

Epilepsy.—This disease, in some of its symptoms, resembles poisoning by prussic acid only. If the symptoms depend on poison, some liquid or substance must have been taken immediately before their occurrence. If, however, nothing has been taken, the inference is that the symptoms most probably depended on disease. Death is commonly very rapid in poisoning by prussic acid; but a first attack of epilepsy is not often fatal. If the person has suffered from previous attacks, the probability is, cæteris paribus, that the symptoms depend on disease. But epilepsy may by coincidence immediately follow the administration of a draught or the taking of food:—an analysis of the substance taken would in such a case remove any doubt. Supposing none of this to be procurable, then we must remember, that epilepsy only simulates narcotic poisoning when the attack is rapidly fatal. Therefore, an opportunity will always present itself for verifying or rebutting the suspicion of poisoning, by examining the contents of the stomach. I have never met with an instance, where a case of epilepsy was mistaken for one of narcotic poisoning.

Diseases of the brain and spinal marrow.—Among these diseases, may be mentioned inflammation of the brain and its membranes, hypertrophy, and the formation of tumours. Such diseases are of a very insidious nature:—they sometimes give no warning of their presence until the person, who may be in his usual health, is suddenly seized with stupor, followed by coma, and he rapidly dies. All such cases resemble poisoning by opium; they can only be distinguished by the discovery of the affirmative characters of disease, on a post-mortem examination, and an absence of poison from the stomach. Besides, the period of access of the symptoms after a meal, and the rapidity of death, will, in many cases, allow a practitioner to form a satisfactory diagnosis.

I have already referred to a case, (antè, p. 38,) where a woman, aged thirty-seven, died suddenly, soon after having taken her breakfast. On an examination of the body, there was found effused within the cranium, a large quantity of bloody serum; and the brain and its membranes were much congested with blood. No poison was discovered in the stomach, and it is certain, that had death been due to a narcotic, some traces of it would have been discovered, in consequence of the great rapidity with which the deceased died. The only points in which this resembled a case of poisoning, were in the invasion of the symptoms soon after a meal, and their rapidly fatal termination.

Diseases of the heart.—The heart is subject to many diseases, which present the same insidious characters, as those of the brain. Thus they may remain for a long time latent, and then suddenly destroy life. They are only likely to be confounded with poisoning by prussic acid, owing to the rapidity with which death takes place. In all these cases, therefore, if the fatal attack suddenly occur some time after food or medicine has been taken, there can be no reason for attributing it to poison. It is only where by a coincidence the symptoms come on at or immediately after something has been swallowed by the patient, that any doubt of the cause to which they may be due, can arise; and here, the doubt would be speedily removed by a post-mortem examination of the body.

We must not expect, however, that in these fatal affections of the heart, well marked post-mortem appearances will be always met with. Some pathologists have described a singular condition of this organ, under which the person dies suddenly after experiencing nausea, vertigo, and fainting. In such cases, the parietes of the heart have been found only preternaturally flaccid, and its cavities empty. This has been called by Mr. Chevalier, idiopathic asphyxia, and others have termed it syncopal asphyxia. It does not appear to be very common, for very little is known concerning it, or on what the cause of death really depends. In regard to its diagnosis in suspected cases, all that we can say is, that if poisoning be not clearly negatived by concurrent circumstances, the usual affirmative characters are entirely wanting.

Distension of the stomach.—This is by no means an unfrequent cause of sudden death. In some instances, the distension of this organ appears to act by inducing apoplexy, the usual marks of that disease being found in the brain. In other cases, death appears to be due to a fatal impression analogous to shock, arising simply from the excessive mechanical distension of the organ: it is not surprising, that a suspicion of poisoning should occasionally arise under such circumstances. I have known several instances to have occurred within the last few years in this metropolis, where the individuals have gone to bed in their usual health after eating a hearty supper, and have been found dead the following morning. On dissection, no marked changes were found, excepting in some, slight congestion of the cerebral vessels.

The most striking appearance was the enormously distended state of the stomach itself.

In December, 1839, a girl aged twenty-two, after eating a hearty supper, retired to rest. In about two hours she was found insensible, and she died in the course of a few minutes afterwards. No post-mortem examination was required by the coroner; although it is difficult to understand why, without it, there should have been any necessity for holding an inquest: as the cause of death, which, however, was probably due to the distension of the stomach, was left unexplained.

In April 1841, a man aged thirty-four, ate a very hearty breakfast, consisting of three-quarters of a pound of beef with bread, and a pint and a-half of coffee. In a few minutes afterwards, he sat on a barrel to rest himself, but almost immediately fell backwards and expired.

This cause of death may be met with in persons of all ages.

In November, 1842, a girl aged thirteen, ate a full breakfast; and about an hour afterwards she became insensible, and died in the course of a short time. The only cause which could be assigned for her death, was over distension of the stomach with food, probably leading to apoplexy.

The following case, which was the subject of an inquest in August, 1841, is of a doubtful nature.

A man aged thirty-seven, who had for some time complained of cramp in the stomach, partook of a full breakfast, consisting of coffee, beafsteaks, and fish. In about half an hour afterwards, he was taken suddenly ill with violent pain and vomiting. He took some salts and cream of tartar; but became worse, and died about three hours after the meal. The verdict was, that the man "died by the visitation of God," whereby the case was left in the same obscurity as before the inquiry.

Rupture of the stomach is said sometimes to occur as a consequence of over-distension, combined with efforts at vomiting. Death is, of course, a speedy consequence of this accident. Hence no difficulty can arise in practice with regard to it, because a post-mortem examination would enable the practitioner at once to determine the cause of death.

When called to examine a case of suspected narcotic poisoning, where the symptoms have occurred soon after a meal, the practitioner must remember that although a full meal is a very common exciting cause of apoplexy, this is not the case with any simple medicine, liquid or solid, which may have been swallowed by the patient. Should the symptoms follow the taking of a draught or any kind of medicine, the circumstances become more suspicious, for the occurrence of apoplexy in such a case, would be a pure coincidence :—all we can say is, that it may happen—in proof of which we may refer to the case mentioned antè, p. 38, and then we require other circumstances to aid our judgment.

In the case of Sir Theodosius Boughton, the narcotic symptoms supervened in two minutes after he had taken, what was supposed to be a simple purgative draught; and it was this fact, no doubt, that strongly influenced the jury in their verdict. The draught, it was presumed, had contained laurel water; and with some strong facts in favour of this presumption, they were unwilling to assume that the symptoms under which the deceased laboured after taking it, were owing to a coincidental attack of apoplexy or epilepsy. In all such cases, it can never be assumed that the medicine taken was the cause of the symptoms, unless we suppose it to have been a poison; while when the symptoms follow an ordinary meal, apoplexy may be a natural result,—at least it is not absolutely necessary, in order to account for them, to suppose that the food contained any poison.

5. THE DISCOVERY OF POISON IN THE FOOD TAKEN, OR IN THE MATTERS VOMITED.

One of the best proofs of poisoning in the living subject, is the detection of poison by chemical analysis either in the food taken by the person labouring under its effects, or in the matters vomited. The evidence is, of course, more satisfactory where the poison is discovered in the matters vomited, than in the food; because this will show that poison has really been taken, and will readily account for the symptoms. If thrown away, we must then examine the food of which the patient may have partaken. Should the results in both cases be negative, the probability is, that the symptoms may have been due to disease.

In investigating a case of poisoning in the living subject, a medical jurist must remember, that poisoning is sometimes *feigned*, and at others, *imputed*. It is very easy for an artful person to put poison into food, and to accuse another of having administered it, as well as to introduce poison into the matters vomited or discharged from the bowels. There are few of these accusers who go so far as to swallow poison under such circumstances, there being a great dread of all poisonous substances among the lower orders; and it will be at once apparent, that it would require a person well versed in toxicology, to feign a series of symptoms which would impose upon a practitioner at all acquainted with the subject. In short, the difficulty reduces itself to this:—what inference can we draw from the chemical detection of poison in food? All that a medical man can do, is to say whether poison be present or not in a particular article of food:—he must leave it to the authorities of the law, to develope the alleged attempt at administration;—but if the poison have been actually administered, then we should have the usual symptoms. With regard to the detection of poison in the matters vomited from the stomach, this affords no decisive proof that it has been swallowed except under two circumstances:—1. When the accuser actually labours under the usual symptoms of poisoning, in which case there can be no feigning, and the question of imputation is a matter to be established by general evidence. 2. When the matters are actually vomited in a *clean vessel* in the presence of the medical attendant himself, or of some person on whose testimony perfect reliance may be placed. An atrocious case of imputed poisoning in which the accused party had a narrow escape has been mentioned antè, p. 36.

CHAPTER VI.

ON THE EVIDENCE OF POISONING IN THE DEAD SUBJECT.

Supposing that the person is dead, and we are required to determine whether the case be one of poisoning or not, we must, in the first instance, endeavour to ascertain all the particulars which have been discussed in the last chapter, as indicative of poisoning in the living subject. Should the deceased have died from poison, the circumstances of the attack, and the symptoms preceding death, ought to correspond with the characters already described.

The additional evidence to be derived from the death of the person may be considered under the following heads.

1. The time at which death takes place after the first occurrence of symptoms.—This question, it is necessary to examine because the more common poisons, when taken in fatal doses, produce their fatal effects within certain periods of time. By an attention to this point, we may, in some instances, be enabled to negative a charge of poisoning, and in others to form an opinion on the kind of poison which has been taken.

In a court of law, a medical practitioner is often required to state the usual period of time, within which poisons prove fatal. It is to be observed, that not only do poisons differ from each other in this respect; but the same substance, according to the form or quantity in which it has been taken, will differ in the rapidity of its action. A large dose of strong prussic acid, i. e. from half an ounce to an ounce, will destroy life with the rapidity of lightning. In ordinary cases of poisoning by this substance, a person dies, i. e. all signs of life have ceased, in about ten minutes:—if he survive half an hour, there is some hope of recovery. Oxalic acid, one of the most energetic of the common poisons, when taken in a dose of from half an ounce to an ounce, may destroy life in from ten minutes to an hour: if the poison be not perfectly dissolved when swallowed, it is a longer time in proving fatal. The strong mineral acids, in poisonous doses, destroy life in about eighteen or twenty-four hours. Arsenic, under the form of arsenious acid (white arsenic), operates fatally in from eighteen hours to three or four days. It has, however, been known to kill a person in two hours; although this is by no means common. Opium, either as a solid or under the form of laudanum, commonly proves fatal in from six to twelve hours; but it has been known to destroy life in three hours:—those who survive the effects of this poison for twelve hours, are said to have a fair chance of recovery.

This must be understood to be merely a statement of the average results, as nearly perhaps as we are warranted in giving an opinion:

but the medical jurist will of course be aware, that the fatal period may be protracted or shortened, according to all those circumstances which have been stated to affect the action of poisons.

There are various forms which this question may assume in a court of law :—the death of a party, alleged to have taken poison, may have occurred too rapidly or too slowly to justify the suspicion of poisoning. The following may serve as an illustration.

A woman of the name of Russell was tried and convicted at the Lewes Summer Assizes in 1826, for the murder of her husband, by poisoning him with arsenic. The poison was detected in the stomach; but the fact of poisoning was disputed by some medical witnesses, for this among other reasons —that the deceased had died *three* hours after the only meal at which the poison could have been administered to him. The authority of Sir A. Cooper and others, was cited to show that according to their experience, they had never known a case to prove fatal in less than seven hours. This may well have been; but, at the same time, there was sufficient authority on the other side, to establish that some cases of arsenical poisoning had actually proved fatal in three or four hours. So far as this objection was concerned, the prisoner was very properly convicted.

On the medical question raised at this trial, I may observe, that within the last few years one distinct case has occurred where the individual died certainly within two hours, after the taking of this poison; and several instances have been reported since the trial, in which death took place in from three to four hours after the administration of arsenic. It seems extraordinary in the present day, that any attempt should have been made by a professional man to negative a charge of criminal poisoning upon so weak a ground as this; but we must remember, that this opinion was expressed seventeen years ago, when the subject of toxicology was but little understood. It is quite obvious, that there is nothing, so far as we know, to prevent arsenic from destroying life in *one hour*. This is a point which can only be settled by a careful observation of cases, and not by any à-priori reasoning or reference to past experience.

In all instances of sudden death, there is generally a strong tendency on the part of the vulgar, to suspect poisoning. They never can be brought to consider, that persons may die a natural death suddenly, as well as slowly; or, as we shall presently see, that death may really take place slowly as in cases of disease, and yet be due to poison. This prejudice continually gives rise to the most unjust suspicions of poisoning; cases illustrating this have already been given antè, (p. 35.) One of the means recommended for distinguishing narcotic poisoning from apoplexy or disease of the heart, is the difference in the rapidity with which death takes place. Thus apoplexy or disease of the heart may prove fatal either instantly or within an hour. The only common poison likely to operate with such fatal rapidity is prussic acid. But when this is the cause of death, some traces of the poison will be found at hand. Besides, a fatal dose of prussic acid is not likely to be conveyed in food. Poisoning by opium is commonly protracted for five or six hours. This poison has never been known to destroy life instantaneously, or in a few minutes. I here exclude morphia and its salts, as being poisons out of common reach. Thus, then, it may happen, that death will occur with such rapidity, as to render it impossible to attribute it to narcotic poison under the circumstances.

Some cases analogous to that which I here quote from Anglada, have been related in a former chapter.

A lady in perfect health, while supping with her husband and family, complained, after having taken two or three mouthfuls, of severe pain in the region of the heart. She fell back in her chair, and died instantly. The parties not having lived on the best of terms, the husband was openly accused of having been accessary to the poisoning of his wife, a circumstance which was rendered still more probable in the opinion of his neighbours, by the fact that his wife had lately made a holographic will in his favour. One of his servants, with whom he was said to live in adultery, was arrested, and a paper containing a white powder was found in her possession. The husband endeavoured to compromise the affair by offering to give up the will. Here, then, were strong moral presumptions of death from poisoning. Three surgeons (experts!) were appointed to examine the body. They opened the abdomen, and observing some green spots on the stomach, (produced, as it afterwards appeared, by imbibition from the gall-bladder,) pronounced an opinion that the organ was in a gangrenous state from the effects of some corrosive poison. Some doubt arising on the correctness of this view, four other surgeons were directed to re-examine the body. They found that the stomach had not even been opened,—its mucous membrane, as well as that of the intestines, was perfectly healthy. It contained a small quantity of undigested food, which was free from any trace of poison. The deceased had died from natural causes. The white powder found in the possession of the servant was nothing more than white sugar.

Had the usual effects of poisons been attended to by the parties who were first called to give evidence in this case, it is obvious that no charge of poisoning could have been made with any shadow of probability. The deceased died suddenly:—there is no common poison which acts so rapidly except strong prussic acid in a very large dose. It was quite impossible that this could have been administered in food. Besides, there was no vomiting before death: hence it followed, that if poison were the cause, the whole of it must have been found in the viscera: but none was discovered.

The great utility of the coroner's inquest in England, when the cause of death is properly investigated, is seen in its removing such suspicions.

Sometimes the only medical evidence on which we may have to speak to the fact of poisoning, will be the duration of the case. There is then of course great difficulty in forming an opinion; but we may generally be able to say whether the time which the party survived after his first illness, was or was not compatible with any known form of poisoning; and also in some instances to determine the probable nature of the poison, if any were really taken by the deceased.

The following case is in some respects interesting. It occurred a few years since in this metropolis, to a gentleman who was then one of my pupils, and consulted me respecting it.

A woman, by occupation a laundress, was found lying dead on the floor of her kitchen The deceased was about forty years of age, of spare make and of temperate habits. When first seen, she was lying on the stone floor in a curved position, on her right side, her right cheek being in a plate which contained four ounces of light brown liquid, mixed with mucus. There was no doubt that this had issued from her mouth by vomiting. The countenance did not express anxiety or pain, but the lips were somewhat drawn in. There was no suffusion about the eyes. The surface was slightly livid. She was but lightly clothed. Some bread and meat were found at a distance, and on a shelf, in a distant part of the kitchen, were some bottles of oil, which had evidently not been touched. No bottle containing poison, nor any weapon was found about the place. There were no marks of violence on the person. The woman had been a little indisposed for about a fortnight previously, and had taken medicine. She, however, was well enough to work. She was last seen alive about five or six o'clock in the afternoon, when she appeared in her usual health, and was heard moving about in her room at half-past nine the same evening:—she was found dead twelve hours afterwards, i. e. at half-past nine the following morning. As the body was quite cold, and the members perfectly rigid when first seen, it is reasonable to presume, that the deceased had been dead at least ten hours—the weather not being very cold at the time. Hence it was probable that she had died about half-past eleven o'clock at night, i. e. about *two hours* after she had been heard moving in her room, and about five or six hours after she was last seen in her usual health and spirits.

From these facts, it was considered very unlikely that she should have died from poison. The only poisons which could be suspected, to prove so rapidly fatal, were prussic acid, opium, or oxalic acid. Had prussic acid been the cause, it would have been easily discovered by the odour as well as by some of the poison being found near. Had opium or oxalic acid been the cause of death, a portion of either of these bodies would have been found in the liquid vomited in the plate, but this contained no trace of any kind of poison. The deceased could not have died very suddenly, since she had had time to take the plate from the sideboard and lie down with it. Had she fallen with the plate in her hand, it must have been broken on the stone floor. Besides, as there were no marks of vomiting on the front of her dress or elsewhere in the room, it is pretty certain that she must have vomited while in the recumbent position. At the inquest, no post-mortem examination was required by the coroner or jury; and therefore it is difficult to say what was really the cause of death. The gentleman who conducted the case, very properly inferred that the deceased had not died from poison.

When a poison destroys life rapidly, it is called a case of *acute* poisoning, to distinguish it from the *chronic* form, i. e. where death takes place slowly. Chronic poisoning is not a subject which often requires medico-legal investigation. Most poisons are capable, when their effects are not rapidly manifested, either from the smallness of the dose or from the timely application of treatment, of slowly undermining the powers of life, and killing the patient by producing emaciation and exhaustion. This is sometimes observed in the action of arsenic and corrosive sublimate, but it has been remarked also in cases of poisoning by the mineral acids and caustic alkalies. Death is here an indirect consequence :—stricture of the œsophagus is induced, or the lining membrane of the stomach is destroyed and the process of digestion impaired :—a condition which leads to emaciation and death. The time at which these indirect effects will prove fatal, is of course liable to vary. A person has been known to die from a stricture of the œsophagus brought on by sulphuric acid, *eleven months* after the poison was swallowed.—(see pòst)—and there is no doubt that instances may occur of a still more protracted nature.

In these cases of chronic poisoning there is considerable difficulty in assigning death exclusively to the original action of the poison, since the habits of life of the party,—a tendency to disease, and other circumstances, may have accelerated a fatal result. To connect a stricture of the œsophagus with the act of poisoning by a mineral acid, it is necessary to show, that there was no tendency to this disease before the acid was administered :—that the symptoms appeared soon after the first effects of the poison went off :—that these symptoms continued to become aggravated until the time of death ; and that there was no other cause to which death could with any probability be referred. These remarks apply equally to the indirect fatal effects of any poison, such, for instance, as the salivation occasionally induced by corrosive sublimate where the acute form of poisoning by that substance has passed away.

It has been said, that chronic poisoning is not a subject commonly requiring a criminal investigation. Two cases have, however, come before our tribunals, in which the facts connected with this form of poisoning, were of some importance. I allude to those of Miss Blandy, tried at Oxford, in 1752, for the murder of her father by arsenic, and of a woman named Butterfield, tried at Croydon, in 1775, for the murder of a Mr. Scawen, by administering corrosive sublimate. In most cases, murderers destroy life by administering poison in very large doses ; but in these instances, small doses were given at intervals, a fact which led to great medical doubt of the real cause of the symptoms before death. It is, however, very rare to hear of this form of poisoning.

It has been already remarked, that some poisons have what is called an *accumulative* property, i. e. they may be administered for some time in small doses without producing any marked effects, but they will perhaps, after a certain period, suddenly and unexpectedly give rise to violent symptoms affecting the life of a person. This peculiar mode of action has been witnessed more in medical practice, than in cases of attempts to poison ; hence it is not a subject of much importance to a medical jurist. Foxglove (digitalis) is said to possess this property, and it has been remarked that on more than one occasion, persons to whom this medicine has been repeatedly administered in small doses, have suddenly died, probably from the accumulative properties of the poison. The same effect has been noticed in the case of prussic acid.

2. Evidence from post-mortem appearances.—One of the chief means of determining whether a person has died from poison is an examination of the body after death. In relation to external appearances, there are none indicative of poisoning upon which we can safely rely. It was formerly supposed, that the bodies of persons who were poisoned, putrefied more readily than those of others who had died from natural disease ; and evidence for or against poisoning, was at one time drawn from the external appearance of the body. This is now known to be

an error; the bodies of persons poisoned, are not more rapidly decomposed, cæteris paribus, than those of others who have died a sudden and violent death from any cause whatever.

Irritant poisons act chiefly upon the stomach and intestines, which they irritate, inflame and corrode. We may likewise meet with all the consequences of inflammation, such as ulceration, perforation, and gangrene. Sometimes the coats of the viscera are thickened, at other times thinned, by the action of an irritant.

Narcotic poisons do not commonly leave any well-marked post-mortem appearances. The stomach and intestines present no unnatural changes. There is greater or less fulness of the cerebral vessels; but even this is often so slight as to escape notice, unless attention be particularly directed to the brain. Extravasation of blood is rarely found.

The Narcotico-Irritants affect either the brain or alimentary canal, and commonly both, according to their peculiar mode of action.

In concluding this brief notice, it must be observed that both irritants and narcotics may destroy life without leaving any appreciable changes in the body. To such cases as these, the remarks, about to be made, do not apply. The evidence of poisoning must then be derived from other sources.

Any evidence derivable from the appearances in the body of a person poisoned would be of no value unless we were able to distinguish them from those analogous changes, often met with as a result of ordinary disease. These are confined to the mucous membrane of the stomach and bowels. They are redness, ulceration, softening, and perforation. All of these conditions may depend upon disease as well as upon the action of irritant poison.

Redness.—It is a main character of the irritants to produce redness of the mucous membrane of the stomach and small intestines. This redness, when first seen, is usually of a deep crimson colour, becoming brighter by exposure to air. It is sometimes diffused over the whole mucous membrane:—at other times in patches over the surface of the stomach. It is sometimes met with at the smaller, but more commonly at the larger extremity of the organ; and then, again, we occasionally find that the rugæ or prominences of the mucous membrane, only present this red or inflamed appearance.

Now in the healthy state, the mucous membrane is pale and white, or nearly so, except during digestion, when it becomes reddened, and some observers have remarked, that a slight redness has often remained in the stomachs of those who have died during the performance of the digestive process. Where in contact with the spleen or liver, the stomach is apt to acquire a deep livid colour from transudation, and it is well known that the bowels acquire a somewhat similar colour from the gravitation of blood, which always takes place after death. None of these appearances are likely to be mistaken for the action of an irritant poison.

Inflammation of the stomach and bowels will cause appearances similar to those produced by poison. In such cases, there are no means of distinguishing them except by searching for the cause of the inflammation.

There is an important class of cases in which redness of the mucous membrane of the stomach is found after death, not dependent on the action of poison or any assignable cause. These cases, owing to their being so little known and involved in much obscurity, deserve great attention from the medical jurist; since the appearances closely resemble those produced by irritant poison. A person may die without suffering from any symptoms of disordered stomach : but on inspection of the body, a general redness of the mucous membrane of that organ will be found, not distinguishable from the redness which is so commonly seen in arsenical poisoning. Several cases of this kind have occurred at Guy's Hospital; and drawings have been made of the appearance of the stomach, and are now preserved in the Museum collection. A record has been kept of four of these; and it is remarkable that, although in not one of them, before death, were there any symptoms observed indicative of irritation or disease of the stomach;—yet in all, the stomach was found more or less reddened, and in two, extensively so. Such cases are not very common; but the certainty of their having occurred where no poisoning could be suspected, should place the witness on his guard, so that he be not led to countenance a suspicion of poisoning too hastily. In order to distinguish them, we must note whether there have been symptoms during life, and their nature. As, in the above cases, there may have been no symptoms, or they may have only amounted to slight gastric disturbance. Under these circumstances, they could not be mistaken for irritant poisoning. Such cases are only likely to lead into error, those who trust to this post-mortem appearance alone as evidence of poisoning;—but no medical jurist, aware of his duty, could ever be so misled.

This redness of the stomach, may truly occur where there is some ground for suspicion, as in the following case, communicated to the Medical Gazette by Mr. Tyson, of Beccles.

A young woman far advanced in pregnancy, died suddenly in a fit of syncope, soon after rising one morning. She had been in ill-health previously; but nothing existed to indicate that she had taken poison. Indeed, from what has been already said, the suddenness of her death was rather against the suspicion that she had died from such a cause. Yet after death, it was found among other appearances that the mucous membrane of the stomach was inflamed (reddened?) and thrown into rugæ. Although the case was very badly investigated by the coroner, who refused to allow a post-mortem examination, (which was made after the inquest only by consent of the friends,) it appears to me, that this was a case similar to those above described, the redness being due to some unknown cause, but not to poison.

Dr. Yelloly long since remarked, that the mucous membrane of the stomach often presents a high degree of vascularity (redness) in cases of sudden death. He met with this appearance in the stomachs of some executed criminals, whose bodies were examined soon after they had undergone the sentence of the law. In a paper read before the

Med. Chir. Society in November 1835, this gentleman has re-examined the whole subject, and has given the results of numerous observations. They are of great interest to the medical jurist. Dr. Yelloly has endeavoured to show :—1. That vascular fulness of the lining membrane of the stomach, whether florid or dark coloured, is not a special mark of disease, because it is not inconsistent with a previous state of perfect health. 2. That those pathologists were deceived, who supposed, from the existence of this redness in the stomach, that gastritis sometimes existed without symptoms. 3. That erroneous conclusions as to the cause of death were frequently owing to the same mistaken observations :—the effects of putrefaction and spontaneous changes induced by the loss of vitality, being sometimes attributed to the action of poisons. 4. That the vascularity in question, is entirely venous, the florid state of the vessels arising from the arterial character of the blood remaining in the veins for some time after its transmission from the arterial capillaries at the close of life :—the appearance is however sometimes due to transudation only. 5. That the fact of inflammation having existed previously to death, cannot be inferred merely from the aspect of the vessels in a dead part :—there must at least have been symptoms during life. (See Medical Gazette, vol. xvii. p. 309.)

Andral and other pathologists have adopted similar views, and these views have obviously a most important bearing upon medico-legal practice : since there is generally a tendency to suspect poisoning wherever redness of the mucous membrane of the stomach is met with in the dead. Such a condition does not even prove the past existence of inflammation, unless there were symptoms during life or other marked effects of the inflammatory process in the alimentary canal. It can be no sign of poisoning, unless the presumption be supported by evidence from symptoms, or by the discovery of the poison : the absence of poison may however be sometimes easily explained by circumstances.

A case is mentioned by Foderé, where, in a person who died suddenly, and poisoning was suspected, the œsophagus and stomach were found reddened. This was at first considered to be a confirmation of a suspicion, that the deceased had died from poison ; but on inquiry, it was ascertained, that the redness was due to the colouring matter of a strong infusion of red poppies, which the deceased had been in the habit of taking. It is not likely that any person, moderately informed in his profession, would fall into such a mistake as this, the means of distinguishing all red colours by chemical tests being so very simple.

The redness of the stomach, in cases of poisoning, is so speedily altered by putrefaction, when circumstances are favourable to this process, as to render it impossible for a witness to speak with any certainty upon its origin. Putrefactive infiltration from the blood contained in the adjacent viscera and muscles, will give a reddish coloured appearance to a stomach, otherwise in a healthy condition. Great dispute has arisen as to how long a time the redness of the stomach in irritant poisoning will be recognizable and easily distinguished from putrefactive changes. It is, perhaps, sufficient to say, that no certain rule can be laid down on the subject: it must be left to the knowledge and discretion of the witness. If there be the least doubt on the origin of the discoloration, we cannot safely rely upon it, as evidence of poisoning. In the Boughton case,—the medical witnesses stated that the stomach and viscera of the deceased were red, and presented the appearance of inflammation. In answer to a question put to him on the subject, the crown witness, Dr. Rattray, said, that *" the post-mortem appearances confirmed his opinion of poisoning by laurel-water, so far as he might be allowed to form a judgment upon appearances so long after death."* This very ambiguous answer led to the following cross-examination by the counsel for the prisoner.

C. " By your putting your answer in that way, do you or do you not mean to say that all judgment in such a case is unfounded?"

W. " I cannot say that, because from the analogy between the appearances in that body, and those distinguishable in animals killed by the poison I have just mentioned, I think them so much alike, that I am rather confirmed in my opinion with respect to the operation of the draught."

C. " Those bodies were *instantaneously* opened?"

W. " Yes, so much so, that there was the peristaltic motion of the bowels upon their being pricked."

C. " This," (the examination of deceased's body) " was upon the *eleventh* day after Sir Theodosius's death?"

W. " Yes."—(Report of the trial of Donellan).

Here it will be seen that the witness was comparing the appearances in the bodies of dogs *immediately* after they had been killed by poison, with those met with in the stomach of a person who had died *eleven* days before, and whose body had been buried and exhumed. The comparison was wrong as a matter of medical evidence; but even had it been correctly made, it would have proved nothing in relation to the poison administered, (laurel-water,) the effect of which is not to produce redness of the stomach.

Ulceration.—In irritant poisoning, the stomach is occasionally found ulcerated; but this is, comparatively speaking, a rare occurrence. In such cases, the mucous membrane is removed in small distinct circular patches, in the edges of which, the poison (arsenic) is often found lodged.

Ulceration of the stomach is perhaps a more common result of disease, than of the action of poison. As a consequence of disease, it is very insidious, going on often for weeks together, without giving any indication of its existence, except perhaps slight gastric disturbance, with occasional nausea, vomiting, and loss of appetite. In this case, the ulceration is commonly seen in small circumscribed patches. It is worthy of remark, as one means of diagnosis, that ulceration has never been known to take place from arsenic or any irritant poison, until symptoms indicative of poisoning have occurred. In ulceration from disease, the mucous membrane is commonly only reddened in the neighbourhood of the ulcer. In ulceration from poison, the redness is generally diffused over other parts of the stomach, as well as over the duodenum and small intestines. A case occurred in Guy's Hospital, some years ago, where, with a small circular patch of ulceration near the cardiac opening, the whole mucous membrane was red and injected:—but this singular condition of the stomach, so closely resembling the effects of an irritant poison, was unaccompanied by any marked symptoms during life. The history of a case previous to death will thus commonly enable us to determine, to what cause the ulceration found, may be due.

Care must be taken to distinguish ulceration from corrosion. Ulceration is a vital process, the substance of a part is removed by the absorbents as a simple result of inflammation. Corrosion, on the other hand, is a chemical action;—the parts are removed by the immediate contact of the poison; they are decomposed:—their vitality is destroyed, and they combine with the corrosive matter itself. Ulceration requires time for its establishment, while corrosion is generally an instantaneous effect.

Softening.—The coats of the stomach are sometimes found so soft, as to yield and break down under very slight pressure, and this may be the result either of poisoning or of some spontaneous morbid change in its structure. As this change in the stomach, when caused by poison, is commonly produced by those substances only, which possess corrosive properties, it follows that in such cases, traces of their action will be found in the mouth, fauces, and œsophagus. In softening from disease, the change will be confined to the stomach alone. When softening is really caused by an irritant poison, it is generally attended by other striking and unambiguous marks of its operation. Softening is not to be regarded as a character of poisoning: it is only an occasional appearance. I have met with a case, in which the coats of the stomach were considerably hardened by sulphuric acid. Softening can never be inferred to have proceeded from poison, unless other well-marked changes are present, or unless the poison be discovered in the softened parts. The stomachs of infants have been found softened from natural causes:—such cases could not be mistaken for poisoning, since the history during life,—the want of other appearances indicative of poisoning, and the total absence of poison from the viscera, would prevent such a suspicion from being entertained.

Perforation.—The stomach may become perforated either as a result of poisoning or disease.

Perforation from poisoning.—This may occur in two ways: 1. By corrosion; 2. By ulceration.

The perforation by corrosion, is by far the most common variety of perforation from poisoning. It is occasionally witnessed where the strong mineral acids have been taken, especially the sulphuric acid:—the stomach in such cases, is blackened and extensively destroyed,—

the aperture is large, the edges rough and regular, and the coats become easily lacerated. The poison escapes into the abdomen, and may be easily detected by chemical analysis.

The perforation from ulceration, caused by irritant poison, is but little known. There are, so far as I know, only three instances on record. In a great number of poisoned subjects examined during many years past at Guy's hospital, not a single case has occurred. It must then be looked upon as a very rare appearance in cases of irritant poisoning.

Perforation from disease.—This is by no means an unusual occurrence. Many cases of this description, will be found reported elsewhere. (Guy's Hosp. Rep. No. 8.) It is invariably fatal when it proceeds so far as that the contents of the stomach escape into the abdomen ; but sometimes the stomach becomes glued to the pancreas during the ulcerative process, and then the individual may recover. Several specimens of this kind of adhesion have been met with in post-mortem inspections. The symptoms from perforation commonly attack the individual suddenly, apparently while enjoying perfect health. Thus then these cases may be easily mistaken for those of irritant poisoning. The principal facts observed with regard to this formidable disease, are the following :—

1. It often attacks young females from eighteen to twenty-three years of age.

2. The preceding illness is extremely slight, sometimes there is only loss of appetite with uneasiness after eating.

3. The attack commences with a sudden and most severe pain in the abdomen, generally soon after a meal. In irritant poisoning, the pain usually comes on gradually, and slowly increases in severity.

4. Vomiting, if it exist at all, is commonly slight, and is chiefly confined to what is swallowed. There is no purging :—the bowels are generally constipated. In irritant poisoning, the vomiting is usually severe, and diarrhea seldom wanting.

5. The person dies commonly in from eighteen to thirty-six hours :—this is also the average period of death in the most common form of irritant poisoning, i. e. by arsenic ;—but in no case yet recorded, has arsenic produced perforation of the stomach, within twenty-four hours; and it appears probable that a considerable time must elapse before such an effect would be produced by this or any irritant.

6. In perforation from disease, the symptoms and death are clearly referable to peritonitis.

7. In the perforation from disease, the aperture is commonly of an oval or rounded form, about half an inch in diameter, situated in or near the lesser curvature of the stomach, and the edges are smooth. The margin of the aperture is often blackened, and the aperture itself is funnel-shaped from within outwards, i. e. the mucous coat is the most removed, and the outer or peritoneal coat the least. The coats of the stomach, round the edge of the aperture, are usually thickened for

some distance; and when cut, they have almost a cartilaginous hardness.

These characters of the aperture, will not indicate, whether it be the result of poisoning or disease; although the absence of poison from the stomach, with the want of other characteristic marks of irritant poisoning, would enable us to say, that disease was the cause. Besides, the history of the case during life, would materially assist us in our diagnosis.

The great risk in all these cases, is that the effects of disease may be mistaken for those of poisoning; for we are not likely to mistake a perforation caused by irritant poison for the result of disease. Among numerous cases, tending to show the medico-legal importance of this subject, I shall select one, which lately came before Mr. Hilton and myself for examination.

A female in a noble family, aged twenty-three, died somewhat suddenly under suspicious circumstances. She had been unwell for about three weeks, and was subject to occasional vomiting and disturbance of the stomach. Still, her illness was so slight that it did not in the least interfere with the performance of her usual duties. One afternoon, about four o'clock, and about three hours after her last meal, she was suddenly seized with the most excruciating pain in the abdomen, and violent vomiting. Her skin was cold and clammy, and the abdomen tender and painful. It was suspected that she had taken poison; and magnesia and sulphate of magnesia were given to her. No poison was found in the room, and she strongly denied the imputation. The symptoms became worse, the vomiting more violent, and she died the following morning about fifteen hours after her first seizure. On inspection, all the organs were found healthy, except those of the abdomen. There were here strong marks of peritoneal inflammation: the intestines were loosely adherent to each other, and a quantity of lymph was effused around them. The cavity contained about a pint of liquid, which had escaped from an aperture in the stomach. This liquid was reserved for analysis. The stomach was laid open by making an incision along its greater curvature. It was empty At the upper and posterior part near the pyloric end of the smaller curvature, was an opening of an oval shape, about half an inch in its longest diameter. The edges were firm, hard and smooth, presenting not the least appearance of laceration or ulceration. They were bevelled off from within outwards, being thinned towards the peritoneal coat, the aperture in which, was much smaller than that in the mucous membrane. There was no sign of inflammation in the membranes around; but the peritoneum, about the edge of the aperture, had a black appearance, and the coats of the stomach were thickened. At the lower part near the larger curvature, there were thick, irregular, black striæ, the mucous membrane being raised and blackened, but not softened These striæ appeared like those produced by sulphuric acid; but there was no corrosion, and on applying test paper there was no acid reaction. The black matter was interspersed with a yellowish coloured substance.

The liquids taken from the abdomen, as well as the coats of the stomach, were chemically examined; but not a trace of poison could be detected. Considering the time of the occurrence of the symptoms, their nature, the absence of poison from the viscera and their contents, the suspicion of poisoning was at once negatived, especially when the above facts were taken with the post-mortem appearances. The medical opinion given was, 1. That the deceased had died from peritonitis, caused by extravasation of the contents of the stomach. 2. That this extravasation was owing to a perforation of the coats of the organ, caused by slow and insidious disease, and not by poison.

SPONTANEOUS PERFORATION.—The stomach is occasionally subject to a spontaneous change, by which its coats become softened and give way. As the extravasation of the contents of the organ in such a case never gives rise to peritoneal inflammation, and no symptoms occur prior to death to indicate the existence of so extensive a destruction of parts, it is presumed to be a post-mortem change, and the stomach is supposed to undergo a process of solution soon after death. It is commonly attributed to the action of the gastric juice, but the real cause of the change is not explained. It is so extremely rare, that during a period of fourteen years, there is the record of only one case occurring in the very numerous inspections made at Guy's Hospital.

The aperture is large, irregular, and ragged at the edges, having the appearance of being scraped off; the mucous membrane of the stomach is not found inflamed. It can only be confounded with perforation by the action of corrosives, but the well marked symptoms during life, and the detection of the poison after death, together with the changes in the fauces and œsophagus, will at once indicate the perforation by poison.

The only case in which any mistake is likely to occur, is where, conjoined with the discovery of perforation after death, there may have existed symptoms of irritation in the alimentary canal during life. It is possible that a person may die under symptoms somewhat resembling irritant poisoning, and after death the gastric secretion may destroy the parietes of the stomach; but such a singular combination of circumstances must be most unusual. That, however, signifies little in a legal point of view, for persons charged with the crime of poisoning are frequently acquitted on the barest medical possibilities. One case of this doubtful character is on record. I allude to that of Miss Burns, for the murder of whom, by poison, a Mr. Angus of Liverpool was tried in the year 1808. It is not necessary to enter into the particulars of the case; since the post-mortem appearances are imperfectly described in the report. Although the symptoms resembling irritant poisoning, under which the deceased laboured, were not accounted for, yet there was great reason to believe that they were not connected with the perforation found in the stomach, which, on the whole, bore the characters assigned to that produced by the gastric secretion. The charge of poisoning was not sustained by chemical or pathological evidence, and the prisoner was acquitted. The evidence given on this trial is well worthy of the attention of every medical practitioner. It shows on what a nice balance of proofs charges of poisoning sometimes rest, and how important it is that a medical jurist should be acquainted with all the circumstances under which perforations of the stomach may occur.

3. CHEMICAL ANALYSIS.—The last branch of the evidence of poisoning in the dead subject is that derived from the chemical analysis of the

viscera, or their contents. This of course will tend to confirm or disprove the inference of poisoning drawn from the preceding characters. It will be proper to consider the value of this kind of evidence in another chapter.

CHAPTER VII.

ON THE EVIDENCE OF POISONING FROM CHEMICAL ANALYSIS.

It has been supposed that chemical evidence of poisoning was always necessary, and that the *corpus delicti* was not made out, unless the poison were discovered by a chemical analysis. This, however, is not a correct view of the matter. There are many poisons which cannot, at present, be detected by chemical analysis, and among those susceptible of analysis, there are numerous circumstances which may occur to prevent their detection in the food, the vomited matters or the contents of the viscera in the dead. If such a rule of law were adopted, it would therefore allow many criminals to go unpunished. All that is required legally, is that there should be satisfactory proof of a person having died from poison;—the discovery of poison in the body is not always evidence of its having caused death, nor is its non-discovery evidence that death has not been caused by it. If by the symptoms and post-mortem appearances, with or without moral circumstances, it can be made clear to the minds of a jury, that death has been caused by poison, nothing more is required; the evidence from chemical analysis may then be safely dispensed with. In cases of murder, the law commonly requires that the body of the deceased should be produced, in order that the cause of death may be verified; but this is not absolutely necessary, for several convictions for murder have very properly taken place where the bodies of the murdered persons have not been forthcoming. Thus then we must not suppose that a charge of poisoning cannot be sustained without chemical evidence being produced of the nature of the substance taken. The fact of a poison having been used, as well as its nature, may be determined from other circumstances. In the case of Donellan already referred to, the only evidence of the nature of the poison used, was the odour perceived by a non-professional person. The effects which followed, made up for the want of clear chemical proof of its nature. As some objections have been offered to the propriety of a conviction in this case, I may refer to two others:—one the case of a man named Thom, tried at the Aberdeen Autumn Circuit, 1821, for poisoning a person named Mitchell with arsenic. No trace of poison could be detected; but a conviction very properly took place on evidence from symptoms and post-mortem appearances, coupled with moral circumstances. A still more recent instance occurred at the Monaghan

Lent Assizes, 1841, where a woman was convicted of poisoning her husband, although the nature of the poison could not be determined by the most carefully conducted chemical analysis. The poison was considered to have been aconite. (See also Humphrey's case, p. 36.)

On the other hand, where the other branches of evidence are weak or defective, the detection of the poison by chemical analysis becomes of such importance, that if it fails, an acquittal will follow. Conjoined with strong moral circumstances, chemical evidence will often lead to conviction where post-mortem appearances are entirely wanting, and the evidence from symptoms is very imperfect. The great value of chemical evidence in otherwise doubtful cases of poisoning, was never so strongly shown as at the trial of Mary Ann Burdock at Bristol, in 1835, for poisoning Clara Smith with orpiment. The deceased had been dead and buried fourteen months. The body was exhumed, and the poison discovered in the stomach and viscera. It must be clear to all medical jurists, that had it not been for the detection of the poison in the viscera after this long period of time, the prisoner would most probably have been acquitted. We cannot be surprised to find that it is this branch of evidence which is deemed most satisfactory to the public mind, and which is earnestly sought for by our law authorities on charges of poisoning. The reason is, that in most cases, it demonstrates at once the means of death; while symptoms and post-mortem appearances are, as we have seen, fallible criteria, unless many circumstances, often difficult of appreciation, are fully considered by the medical witnes.

Before proceeding to the analysis of any suspected substance, we should, if possible, make ourselves fully acquainted either with the symptoms or post-mortem appearances, or both, observed in the person suspected to have been poisoned. We may by a knowledge of these facts determine, à-priori, whether we shall have to search for a narcotic, irritant, or corrosive poison. The kind of poison may often be predicted from the symptoms and post-mortem appearances, and our analysis directed accordingly. I have known more than one instance, where an irritant poison has been sought for in the contents of the stomach, when every fact connected with the death of the party, as well as the rapidity with which death took place, tended clearly to show that if any poison had been used, it must have been one of the pure narcotics. It is not unusual to find the examination of medical witnesses misconducted in courts of law, in relation to the effects of poisons. The deceased may have died from a narcotic, while questions relative to the action of irritants alone, will be put by the counsel for the prosecution and defence.

The chemical evidence may be divided into several branches. The analysis may extend

1. To the pure poison. We may be required to state the nature of a substance (part of the poison administered) found in the possession of a prisoner.

2. The analysis may be confined to a part of the substance of which

the affected party partook, and here the poison is usually mixed up with liquids or solids of an organic nature. The steps of the analysis become then rather more difficult.

a. There may have been various substances combined in a meal, and the poison have been mixed with one substance only. This will show the necessity for examining separately the various articles used at a meal, if we wish to discover the real vehicle of the poison.

b. Symptoms of poisoning may occur after the eating of a pudding. A part of the pudding may be analysed, and no poison discovered; because the poison, instead of being incorporated with the dough, may have been loosely sprinkled like flour over the exterior only.

c. A similar circumstance may occur in the poisoning of a dish of meat. The gravy may be poisoned, and not the meat. A case of this kind occurred to Dr. Christison. A whole family were attacked with symptoms of poisoning after a meal on roast beef. The meat was examined, but no poison could be discovered. It was then ascertained that the poison had been mixed with the gravy, and those who had taken the meat without the gravy, suffered but slightly.

In the case of the Bodles, tried in 1833, the deceased was proved to have been poisoned by arsenic administered in coffee. The coffee was kept ground in a bottle, to which every one of the family had access; and there could be but little doubt, from the circumstantial evidence, that the arsenic had been mixed with the coffee in this bottle. A careful examination of the coffee remaining in the bottle was made, but no trace of arsenic could be detected. The poison had most probably been mixed with the *upper stratum* only of the powdered coffee, and the whole of the poisoned portion had been used for breakfast.

These facts are of some medico-legal importance; they will often enable a witness to explain certain anomalies in cases of poisoning. By bearing them in mind, it is easy to understand, how it is that one or two persons only will suffer at a meal made in common or on the same article of food, while others will escape.

3. The chemical analysis may be directed to the matters *vomited* and evacuated. In irritant poisoning, a large quantity of poison is often expelled in this way, and may be detected especially in the matter first vomited.

4. If death has ensued, an analysis of the contents of the stomach and intestines must be made. Supposing no vomiting to have occurred, or that this has been slight, then we may expect to find abundant traces of the poison in the viscera. If no poison should be found in the stomach, the contents of the duodenum and the other small intestines must be separately examined.

It is obvious that one or several of these sources of chemical evidence may be wanting, and it is rare in any one case of chemical poisoning that all are open to the medical witness. The detection of poison in the vomited matters during life, and in the viscera after death, is of course the most satisfactory kind of chemical evidence; since cæteris paribus it is a clear proof of poison having really been taken. It is difficult to admit the supposition that it should have been designedly introduced after death; besides, in such a case, the absence of all marks of vital reaction, and of any symptoms during life indicative of poisoning, would remove any such suspicion.

The presence of poison in the viscera, with such marks of vital reaction as are known to be produced by the particular substance, as for instance, inflammation in the case of the irritants, affords presumptive evidence of death from poison, open to be rebutted by other proofs of death from disease, under which the deceased might have been labouring at the time.

But let us take the case, that chemical evidence is entirely wanting, and that no poison is detected under any of the circumstances mentioned: if there are other facts to render death from poisoning probable, we must endeavour to explain why this important branch of evidence has failed. There are few medical jurists who have not met with cases where, although undoubtedly death was occasioned by poison, whether irritant or narcotic, not a trace of the substance could be detected in the solids or liquids of the body. The non-discovery of poisons in cases of poisoning may depend

1. *On the nature of the Poison.*—In the present state of our knowledge, chemistry, with few exceptions, furnishes us with the means of identifying with certainty a mineral poison only. The greater number of vegetable poisons are beyond the reach of chemical analysis. Botanical characters may sometimes serve to point out the nature of the substance; but only in those instances where the plant has been swallowed with its leaves or other parts entire. If the extract or inspissated juice have been administered, or if the poison were in the form of infusion, tincture or decoction, a chemical analysis will commonly be of no avail. The same remarks apply to the powerful alkaloids extracted from vegetables. It is true, that there are tests for morphia, strychnia, and a few others; but these are on the whole unsatisfactory, as a basis for chemical evidence of poisoning.

Again, poisons which are of a highly volatile nature, may be speedily dissipated; so that in a few hours or a few days after death none may be discovered. Alcohol is well known to pass away so rapidly, that no spirituous odour may be perceived in the contents of the stomach, although the individual may have died speedily, and the body be inspected six or eight hours after death. Prussic acid may be in like manner rapidly dissipated.

2. The non-detection of poison in the viscera may be owing to its having been expelled by excessive *vomiting* and *purging*. In all such cases, however, the poisonous substance ought to be found in the vomited matters. In two instances of poisoning by sulphuric acid,—in two of arsenic, and in one of oxalic acid, although death took place with the usual rapidity, I could not detect any of the respective poisons in the stomachs of the deceased. Similar cases are to be found reported in most works on medical jurisprudence.

It may, however, be fairly inferred that in all cases of irritant poisoning, where the vomiting and purging have been slight, some portion of the poison ought to be found in the body. If none be present, it may be a question whether death was really due to poison. It is not likely that a common dose of arsenic would be entirely removed by absorption. (See the case of the Queen *v.* Hunter, Liverpool Lent Assizes, 1843.)

3. The *form* in which the poison is administered. Solid poisons are usually detected without difficulty, because they are in general administered criminally in very large doses; but in cases of chronic poisoning, i. e. where the substance is administered in small doses at long intervals, chemical analysis will fail; for the poison may become absorbed and eliminated. The late researches of Orfila have proved that some irritants enter into the circulation, and become diffused over the body, even to the extremities of the fingers and toes. In this way, if the dose were small, and taken in a state favourable for absorption, no trace of the substance may be found in the body, unless the muscles and viscera be analysed.

It cannot be denied, that the great facility with which chemical analysis is applied to the detection of most irritant poisons, is due to the ignorance of those who criminally administer them. A mineral poison is commonly given in the form of a loose powder, undissolved; and is then easily susceptible of analysis. Instances of extraordinary depravity have, however, occurred in which persons have shown themselves to be acquainted with these facts, and they have endeavoured so to destroy their victims, as to frustrate the usual means of detection. A case was tried at Mayence in March, 1835, in which the evidence clearly proved, that the prisoners had poisoned the deceased and several persons previously, by administering to them, arsenic, in a saturated solution in water. One of them confessed that she had boiled the poison in water, allowed it to cool, filtered the solution, and then administered it by small quantities at a time in wine, milk, gruel, and other liquids. On one of these occasions, the dose of poison was so large, that it operated with fatal rapidity—a circumstance which led to the detection of the crime. As might have been anticipated, not a trace of arsenic could be discovered on analysing the contents of the viscera of those who had perished in this manner. The quantity of a mineral poison removed by absorption is, however, in all cases extremely small.

4. Lastly, some poisons may be removed by treatment, as under the administration of antidotes and the use of the stomach-pump. Others appear to undergo a change analogous to digestion from the action of the secretions of the stomach upon them. These are chiefly poisons belonging to the organic kingdom; and this has been suggested by Dr. Christison as a reason why in many cases of rapid poisoning by opium, no trace of the poison has been discovered.

A chemical analysis is commonly directed in toxicology to the determination of two points;—1. Of the nature of the poison. 2. Of the proportion, or quantity, in which it has been taken.

The nature of the poison and the probable quantity administered, are usually stated in the indictment; but it is not absolutely necessary for conviction, that the substance thus stated should be proved to have been that which was actually administered. The purposes of the law are considered to be fulfilled if the kind of death be substantially proved :—thus it is only necessary to prove that the person was poisoned. A man may be indicted for administering corrosive sublimate; but the medical evidence may show that the poison was in reality arsenic or prussic acid ;—still the prisoner may be convicted of the crime, the variance in the means alleged being immaterial. This is, in many respects, fortunate; since a person may be convicted in spite of any imperfections existing in the orginal analysis.

The *quantity* of poison administered is generally stated conjecturally; but it is sometimes in the power of a witness, to give a tolerably accurate statement of the quantity taken, when any portion of the original vehicle of the poison is discovered. Thus all solid substances given for analysis should be first weighed ;—and all liquids measured: a quantitative analysis may then be performed at any subsequent period. The chief question in law in regard to the quantity of poison is :—whether it was sufficient to destroy life, or to produce any serious effects? Thus, the malicious intention of a prisoner is often to be inferred from the quantity of poison existing in the substance administered. A case occurred about ten years since, in which a man was capitally indicted for administering oxalic acid with intent to murder. The poison was introduced into coffee, served for the prosecutor's breakfast. There could be no doubt of its presence; but on estimating the quantity, Mr. Barry discovered that it was only in the proportion of about ten grains to a pint, a quantity which he considered insufficient to produce any serious effects on the body. The prisoner was acquitted; but it is obvious, that had the proportion been an ounce to a pint, the malice of his act would have been apparent. This case shows that a medical jurist must not be content with merely determining the presence of poison in suspected liquids,—he should also determine the quantity. The law presumes upon the innocence rather than upon the guilt of an accused party, when the evidence fails in showing from the small quantity of poison administered, that the act was malicious. If a man gave to another a few drops of sulphuric acid in a large quantity of water, we should not infer that his intention was to murder; but if he administered a large quantity of the acid in an undiluted state, the malice of the act would be at once apparent. Presumptions of this kind must, of course, be affected, as well by the nature of the poison as by the moral circumstances adduced in evidence. A prisoner has sometimes alleged in his defence, that he did not know the substance to be a poison, and that he did not administer it with intent to kill. The law, however, properly infers that the highly destructive properties of such substances as arsenic or corrosive sublimate, must have been well known to the prisoner, if an adult, by common repute.

It need hardly be observed, that the quantity found in the stomach or viscera can convey no idea of the quantity actually administered; since more or less of the poison may have been removed by violent vomiting and purging as well as by absorption. But the quantity found in the stomach, even after a portion has been thus lost, is often more than sufficient to destroy the life of a human being.

It is singular that, notwithstanding this very obvious cause for the removal of a poison from the stomach, barristers should so frequently address the inquiry to a medical witness—whether the quantity of poison found in the viscera was sufficient to cause death? Whether this question be answered in the affirmative or negative, is a matter which cannot at all affect the case, since either no traces of poison or but a very small quantity may be found in the viscera, and yet the deceased may have assuredly died from its effects. Thus, then, whether much or little be found, the object of this question is not very apparent; since the fact of death having been caused by poison does not, in the least degree, rest upon the precise quantity which appears to remain in the dead body. It has been truly remarked by Orfila, in regard to arsenic, that that portion of the poison which is found in the stomach, is not that which has caused death; but the surplus of the quantity which has produced fatal effects by its absorption into the system.

In conducting an analysis, the smallest possible quantity of the suspected liquid or solid, should be used. If all were used at one operation, doubts might afterwards arise in the mind of the analyst, which it would be out of his power to remove. By care and ordinary precaution, a few grains will give results as satisfactory as those obtained from several ounces: and there is this additional advantage, that a portion is saved for the corroborative experiments of other analysts, or for correcting those which may have been previously performed.

With respect to the minute quantities of poison which may be detected by chemical processes, some remarks will be made hereafter. It is, indeed, fortunate for the ends of justice, that those poisons commonly selected by criminals, may be discovered when existing in proportions so small as to excite wonder and incredulity in those who are not much acquainted with this department of science. The opinion of an experimentalist as to the presence of poison is never based upon the quantity actually found; for the results may be as infallible with a grain or even the hundredth part of a grain of some substances, as with many ounces. All tests have a limit to their action; and when they act obscurely, or cease to act, the witness is bound to state that the chemical evidence has failed. Arsenic may be, however, safely inferred to be present when we obtain a quantity of the metal scarcely ponderable in the most delicate balance. We might go on with the experiment, and obtain from other portions still larger quantities of the metal; but the evidence of the presence of the poison would not be chemically speaking rendered more conclusive. A toxicologist merely obtains sufficient to enable him to speak safely to the presence of the substance :—what the weight or other properties of the quantity so obtained may be, is a matter of no moment to him.

If a practitioner has not been in the habit of analysing poisons, it is advisable, before he commences the analysis of the substance handed to him, that he should operate several times upon a portion of the same kind of poison as that which is suspected to have been administered. In the employment of chemical tests, it is especially necessary to determine that they are pure before the analysis is commenced. Arsenic may be contained in the sulphuric or muriatic acid used in an analysis of that poison ; and sulphuric acid may be pronounced to be present in the stomach when it may have been contained in the nitric acid employed in the analytical process.

During the examination of a suspected substance, a practitioner is often pressed to give an opinion respecting its nature before the steps of the process are complete. This may arise from the anxiety or curiosity of those who are interested in the proceedings. There is a rule, however, which it appears to me, should always be followed on these occasions ; namely, that no opinion whatever should be expressed until the whole of the analysis is complete. It often happens in the hands of the ablest analyst, that the last steps of a process lead to a result very different from that which was anticipated at the commencement. The truth is :—it is not by one character, but by many, that a poison is identified ; and, therefore, a suspicion derived from a few incipient experiments, is very likely to be overthrown by continuing the investigation. In the Boughton case, Dr. Rattray gave an opinion in the first instance, that the poison administered to the deceased was arsenic ; but he subsequently attributed death to laurel-water. A case occurred, within my knowledge, where arsenic was pronounced to be present when sulphuric acid was really the poison. In another case, tried at the Kingston Assizes in 1832, the medical witness admitted that at the coroner's inquest he stated the poison to be arsenic, but by subsequent experiments he found that it was oxalic acid. This kind of mistake not merely impedes the course of justice by throwing a doubt upon evidence which ought to be, beyond all question, clear and satisfactory ; but it seriously affects the reputation of a witness. It entirely arises from his giving an opinion before he is justified from the facts in so doing. It is, I think, a well-marked line of duty to be pursued on these occasions ;—1. That no opinion should be formed from a few experiments : and 2. That none should be expressed until the analysis is complete. It is obvious that, if a man be compelled to admit in cross-examination at a trial for poisoning, that he has been once mistaken on a question so important and requiring so decided an answer, a jury may be easily induced to believe that the witness may have made a second mistake, and that his then positive opinion is of no more value than that which he first expressed, and afterwards retracted.

CHAPTER VIII.

ON THE EVIDENCE OF POISONING FROM EXPERIMENTS ON ANIMALS.

Some toxicologists have enumerated experiments upon animals as one among the sources of proof in cases of poisoning. This kind of evidence rests upon the assumption, that poisons act on man and the lower animals in the same way. The observations of Orfila, however, tend to show that this is partially true with only two domestic animals, namely, the dog and the cat:—in all other cases, the results by no means accord. With respect to experiments performed on dogs and cats, I quite agree with the opinion expressed by M. Devergie (Médecine Légale, ii. 457) that they are in no case fitted to show the doses in which particular poisons are injurious or fatal to man—nor can they be safely trusted to prove the rapidity of action in different poisons. All that they are fitted for, is to enable us to ascertain whether a particular substance be injurious to animal life or not, but nothing farther. In Donellan's case, this kind of evidence was admitted to show the poisonous effects of laurel-water; and in Freeman's case, tried at Leicester in April, 1829, experiments on animals were received as evidence to prove how speedily prussic acid, in certain doses, will destroy life. These experiments rather led to the presumption that the prisoner was guilty of the murder of a female by administering to her prussic acid; whereas, it was proved by circumstances, that he was innocent. An exclusive reliance upon such experiments is always liable to lead to erroneous medical evidence.

In proof of this statement, I shall here quote the results of some experiments on hydrocyanic acid lately made by Dr. Reid and Dr. Simson. In one, they gave *an ounce* of Scheele's prussic acid to a dog. The animal died in about one minute afterwards. Other dogs of the same size, to which about *six drops* of the same acid, from the same bottle, were given, died in the same period of time; although the dose in the last case was only one-eightieth part of the quantity given in the first experiment. The contractility of the heart was in none of the cases much impaired. (Ed. Med. and Surg. Journal. Oct. 1836, p. 500). From these experiments, it is evident that no fair inference can be drawn of the relative effects of prussic acid on man and animals; for there is no agreement as to the action of the poison on the latter. Doses so widely differing from each other were thus found to kill dogs of similar size within the same period of time.

When the question is merely, whether a suspected substance administered to another, is or is not poisonous, then we may occasionally be justified in resorting to this kind of evidence, in order to determine the fact. Most of the common poisons are, however, capable of having their presence easily demonstrated by a chemical analysis; and the properties of the substance will be thereupon known. But evidence of this description may be sometimes accidentally obtained, and then it will often dispense with a chemical analysis of the vehicle of the poison; and, indeed, may supply proof when no poison is discovered in the body of the deceased. An intelligent barrister related to me the following case which he was engaged in prosecuting on the Western Circuit some years since. A woman poisoned her husband with arsenic mixed in soup; and after the deceased had made a full meal, she threw the remainder out of a window into a farm-yard, thereby thinking to defeat all attempts at discovering the means which she had adopted to destroy her husband. It happened at the time, that a pig and several fowls were feeding under the window, and they ate up what fell on the ground. The whole of these animals died under symptoms of irritant poisoning. The husband also died:—no poison was detected in the stomach, although there were the traces of its action; but on opening the bodies of the animals, the medical witnesses found not only the appearances usually produced by irritant poisons, but arsenic itself was readily discovered in the viscera. This sort of evidence supplied that which was wanted to complete the case:—for while no poison was detected in the body, no portion of the poisoned soup could be procured. The prisoner was convicted and executed.

Good negative as well as affirmative evidence, may be sometimes obtained by the examination of the bodies of animals alleged to have been poisoned or actually poisoned. The following case is singular in this respect:—A woman named Higgins was tried at the Warwick Summer Assizes in August, 1831, for the murder of her uncle by poisoning him with arsenic. Her guilt was throughout made very clear. It was proved that she had bought arsenic, and when required to account for the possession of the poison, she said that it was for the purpose of destroying vermin—the excuse resorted to by all murderers. She went, however, farther than this; and actually pointed out a dead mouse, which she said had been killed by the poison in corroboration of her statement. This turned out to be an unfortunate part of her defence, for the medical witnesses showed that the mouse had not died from the effects of arsenic.

In the above cases, it will be seen that the evidence from the effects of poison was accidental, and ancillary to the main facts of poisoning. There is, however, one instance wherein evidence from experiments on animals cautiously performed, may be of equal importance on a criminal trial. I allude to the case where the poisonous substance is not of a nature readily to admit of a chemical analysis, as for example in substances belonging to the narcotic or narcotico-irritant class of poisons. In such a case, if the death of an animal take place under the ordinary symptoms of poisoning from the administration of a substance, part of which has been taken by the person whose life was then attempted, the evidence is very conclusive. This remark applies only to liquids or solids, which are made the vehicle of the poison; not to any matters vomited or found after death in the stomach. The results here would be fallacious; because such matters may, without containing any poison whatever, give rise to vomiting and other symptoms in an animal.

Foderè mentions a case, where a young child, after having partaken of some broth, fell into a state of stupor—lost all power of deglutition and foamed at the mouth. Some of the meat from which the broth was made, was given to a cat. The animal was seized with convulsive fits, alternating with stupor, and died in about five hours. It was rendered probable from the symptoms, as well as from an examination of the body of this animal, that these effects were caused by the introduction of a narcotic plant (hyoscyamus) into the broth.—(Méd. Lég. t. iv. p. 72.)

The following is, I believe, the most recent case in which this kind of evidence was received in an English court of law.

A woman named Sherrington was tried at the Liverpool Spring Assizes in 1838, for the attempt to administer poison to one Mary Byers.

The evidence showed that the prisoner had sent to the prosecutrix a pudding by two young children. On the way, these children tasted it, and finding that it had an unpleasant taste, the prosecutrix was put on her guard. The pudding was sent to a surgeon to be analysed; but he could detect no poison in it. He suspected, however, that it contained a vegetable narcotic poison. He gave a piece about the size of an egg to a dog. In twenty minutes, the dog became sick—in forty minutes, it lost the use of its limbs—and died in three hours. The prisoner was convicted.

CHAPTER IX.

WAS DEATH CAUSED BY POISON?

We have hitherto considered those facts which indicate in a disputed case whether or not poison has been the cause of death, in a previously healthy subject. We have supposed that the question of poisoning would turn simply on the affirmative or negative, and be established or disproved by the medical evidence. We meet with cases, however, in medico-legal practice, wherein the question presents itself under another aspect. Thus poison may have been taken or administered; the fact of poisoning may be established by the symptoms, post-mortem appearances, and the actual discovery of the substance in the food, in the vomited matters, and in the stomach of the deceased after death. All these points may be freely conceded; but the defence will rest upon the question, "Whether or not, the poison so administered, was actually the cause of death." To establish a charge of murder against a prisoner, it must be proved that poison was certainly and indisputably the cause of death. Any proof short of this, as the existence of mere probability, doubt, or suspicion, will of course lead to an acquittal. Thus, then, the medico-legal question would be :—Was death produced by poison, or by any other latent or secondary cause? And the witness will be required to state which of two probable or co-existing causes, actually destroyed life. It may be remarked, that whenever we obtain those proofs of poisoning which have here been assumed to exist—the presumption is always in favour of poison; but it is not the less necessary for a medical jurist to determine, by a careful inspection of all the cavities of the body, whether death might not have been due to some insidious disease. In a case at all involved in doubt, negative evidence is as important as that which is affirmative; and a great error would be in many cases committed, if the examination of a body was stopped so soon as traces of the action of poison had been discovered. In Donellan's case, the head of the deceased, Sir T. Boughton, was not examined, an omission which might, had the general evidence been less clear, have led to difficulty; for the diseases from which it was alleged that the symptoms of the deceased might have proceeded (apoplexy and epilepsy) have their seat of morbid changes in that part of the body. An inspection of the head might, it is true, have thrown no light upon the question; but that is not the point—a medical witness must not omit this duty, and then excuse himself by saying that no morbid changes might have been found. The assumption will always be as much against him, as in his favour.

Cases in which the administration of poison is admitted, and death referred to some other cause, although not common in courts of law, are sufficiently frequent to demand the serious attention of the practitioner. The following appear to me to embrace the chief points on which a defence of this kind may rest.

1. Death may be caused by improper food.—It has been mentioned in a preceding chapter, (antè, p. 21,) that some kinds of food will cause death under symptoms resembling those of irritant poisoning. Such cases are not common, and they appear to depend often on idiosyncrasy or peculiarity of constitution. If poison be taken with such food, we might safely refer death to the former, provided the case took the usual course; and that death was preceded by all or a majority of the characters peculiar to the kind of poison taken. If any of these characters are wanting, this must weaken the evidence; but in most instances, it will be found that the symptoms of acute poisoning are so well marked as to extinguish those which may have depended upon the unwholesome food. Each case must be judged of by itself; no general rules for a decision can be laid down. Still it must be remembered, that death is not a very common consequence of unwholesome food, while it is the usual result of an active poison.

2. Death may be caused by disease.—This is a case which more frequently presents itself for our consideration; since poison is often administered to persons while labouring under disease. On a

post-mortem examination, we may find, besides indications of poison, marks of extensive disease. When this is the case, the main point to be considered is, whether the disease has advanced to that degree to account for rapid or sudden death; for this is one of the main characters of acute poisoning. Should the history of the case be known, our judgment may be assisted by observing whether the symptoms preceding death were referrible to a diseased condition of the body or to poison. We cannot deny that singular coincidences may here occur. A man may have taken irritant poison, and yet death be occasioned by abscess in the brain, the lungs, by sudden hæmorrhage, or by other causes. If the poison were of a nature to cut short life suddenly, we could not hesitate to refer death to it. Thus it is scarcely possible to admit, when prussic acid is the poison, that death should be referred to some diseased condition of the body found on a post-mortem examination. Whether the person be labouring under illness or not, the taking of this poison would be sufficient to account for death. It is not always so easy, however, to determine this question in other cases of poisoning; for whether the substance taken be opium or arsenic, there is time for latent disease of the heart, brain, or lungs, to cut short life. The history of the symptoms preceding death, will enable us in general to return an answer. Without this history, a medical opinion can be little more than a mere conjecture.

Several complex cases of this description have occurred in reference to diseases of the stomach, those labouring under such diseases having had poison administered to them. Thus, the organ may be found perforated; and the question will be not so much what caused the perforation, as whether the perforation or the poison caused death.

A woman swallowed, by mistake, half an ounce of powdered chloride of barium dissolved in warm water. Nausea and vomiting of a watery mucus supervened, with twitchings of the facial muscles. and convulsive motions of the hands and feet. The symptoms continued to increase in severity, and she died about two hours from the time of taking the poison under the most violent convulsions. On inspection, the stomach was found perforated posteriorly, in the lesser curvature near the cardiac orifice. The aperture was of an oval form, three lines in diameter externally, and almost twice as large internally. The margin appeared swollen, and the mucous membrane, for about two inches round, was much thickened and covered with a bloody mucus. The stomach and small intestines were highly inflamed:—the cavity of the former contained mucus and coagulated blood. The pharynx and œsophagus presented slight marks of inflammation. The poison was found in the stomach by chemical analysis.

Wildberg, who has reported this case, suggested that the perforation was due to the previous disease and not to the poison taken. This is very probable, for the characters of the aperture were those of perforation from disease; and it would be very unlikely that the chloride of barium, if it led to perforation of the stomach at all, should have given rise to this effect in two hours. It is not stated, whether the woman suffered from any symptoms of gastric irritation prior to taking the poison—nor whether the contents of the stomach were found extravasated and the peritoneum inflamed. But there can be no doubt that the woman died from the effects of the poison. This was clearly indicated by the nature of the symptoms and the post-mortem appearances. Admitting that no mistake was made respecting the time at which the poison was swallowed, it must be considered remarkable that this substance should have destroyed life, and left such extensive marks of irritation in the alimentary canal, in the short space of two hours.

The following case was tried at the Taunton Spring Assizes, 1836.

Sophia Edney was charged with the murder of her husband, by poisoning him with arsenic. It appeared in evidence, that the deceased was attacked with severe pain in the abdomen and vomiting shortly after having eaten his dinner, which was prepared for him by the prisoner. Medical assistance was called in; but the man became worse, and he died in sixty hours after the first attack. It was shown that arsenic had been probably given to him at the dinner; and also on several other occasions, when it was supposed to have been substituted for some medicine prescribed for him, his symptoms having been uniformly aggravated after each dose. The chemical evidence was very clear:—arsenic was discovered in the vessel in which the dinner was dressed; also in the stomach of the deceased, and the poison was traced to the possession of the prisoner. On an examination of the body, a schirrous ulcer was found in the stomach near the pyloric orifice, which was evidently of long standing. It was about the size of a shilling, had a dark appearance, and the margin was inflamed. The mucous membrane of the stomach, as well as the duodenum, was in such a high state of inflammation that it resembled red velvet. The defence on the trial was, that the symptoms and death of the deceased were due to the schirrous ulcer, and not to poison. It was shown that the deceased had suffered from a gnawing pain in the stomach for a very long period; and it was thought by himself, as well as by others, who saw him, that this last attack of illness was nothing more than an aggravation of his old complaint. The medical witness, however, did not hesitate to refer the symptoms and death to arsenic for the following reasons:—the symptoms occurred suddenly and violently after a meal, at which arsenic was proved to have been administered. Some of these symptoms were peculiar to arsenic, and totally unconnected with the disease under which deceased was labouring. Pain and vomiting might be ascribed to either cause; but the intense thirst not previously experienced, well-marked inflammation of the conjunctivæ, coldness of the body, and before death paralysis of the extremities with loss of sight, were symptoms unquestionably owing to the operation of arsenic, and not to the effect of chronic disease. This disease was not likely to destroy life with such rapidity and under such severe symptoms. The post-mortem appearances corroborated the opinion founded on the symptoms, and showed that death was really due to an active irritant poison. The woman was convicted upon this evidence.

The next case occurred in Germany a few years since.

A woman, after an illness of many weeks, during which she was subject to constant vomiting and other symptoms of disease in the stomach, died suddenly under suspicious circumstances, and her husband was accused of having poisoned her. The parties had lived unhappily together. The prisoner, under the pretence of relieving her disorder, gave her a white powder and a mixture of *boletus cervinus.* Soon after taking this powder she became much worse—severe pain in the abdomen and diarrhea came on. She died nine days after taking the powder; and a physician who saw her shortly before death, considered her to be labouring under the effects of irritant poison. The deceased gave to the physician the glass from which she had taken the medicine. This contained a white powder, which, on examination, proved to be arsenic. The chief marked appearances were in the stomach. The whole of the interior was of dull reddish brown colour:—the lining membrane being in some parts so softened as to have a gelatinous consistency. About half an inch from the pylorus, there was a perforation of the coats of the organ. The edges of the aperture were hard, and had a cicatrized appearance. The stomach contained about twelve ounces of a reddish coloured liquid. The intestines were slightly inflamed. The medicine alleged to have been given by the prisoner to the deceased, was proved to have been arsenic in a decoction of the *boletus cervinus.*

The contents of the stomach and intestines yielded no trace of poison, but the analysis does not appear from the report to have been very skilfully conducted. The medical opinion given at the trial, was, that the deceased had died from arsenic, and not, as was alleged, from disease. The prisoner was acquitted of the charge, the court doubting the correctness of the medical opinion in favour of death from poison. The witnesses were asked, whether they would swear, from the post-mortem appearances *alone*, that the deceased had died from arsenic, but this they declined doing. The previous disease of the stomach, and illness of the deceased, were, in the judgment of the court, a sufficient cause of the symptoms and death. It is proper to state also, that the evidence of administration by the prisoner was defective.—(Rust's Magazin, 1837. 50 B. 2 H.)

The two following cases are related by Henke. A young girl died under suspicious circumstances, and an inspection of the body was ordered. The viscera were found healthy, except those of the abdomen. The stomach contained three ounces of reddish coloured liquid. Its mucous membrane was of a dark red colour, and near the pylorus were several spots of a clear yellow hue. The contents of the stomach, on analysis, yielded arsenic. The account given by the mother, was that the deceased, some weeks before, had met with a fall, after which she complained of pain in her side. Shortly before her death, she said she felt ill, and vomited repeatedly,—she went to bed early, and died without being convulsed. The medical opinion was, that she had been poisoned ; but the court held, that the fact of poisoning was not proved, and the prisoner, charged with the crime, was acquitted.

This case shows that there is great difficulty in forming a medical opinion, where there is no satisfactory account of the symptoms preceding death.

In the next case, a man was charged with having given to his wife, who had been for a long time ill, a small quantity of arsenic, in four different doses. The only symptoms that followed, were general illness and vomiting. Another, and stronger dose was then, it is supposed, administered ; and after suffering severe pain, the woman died the day following. The body was inspected twenty-four hours afterwards. In the abdomen, the pancreas was found enlarged and in a schirrous state, evidently proceeding from chronic disease. The lining membrane of the stomach was inflamed, and it presented gangrenous spots. It contained a greyish coloured liquid having a gritty feel. The uterus was in a state of schirrous enlargement. The contents of the stomach, on analysis, were found to contain arsenic.

The medical opinion was, that notwithstanding the marks of extensive disease in the viscera of the abdomen, the post-mortem appearances and the detection of the poison in the viscera proved, that the deceased had died from arsenic. The counsel. in defence, raised objections to this view, on the ground that the head had not been examined, and that the chemical analysis was defective. The faculty of Leipsic being appealed to, overruled the objections. The diseased state of the pancreas, might, in their opinion, have given rise to vomiting, emaciation, and death, but not to so sudden a death. The chemical analysis, although in some respects defective, sufficiently demonstrated the presence of arsenic in the viscera.—(Zeitschrift der S. A.)

The longer life is protracted after the supposed administration of poison, the more difficult becomes the decision.

The following case, which occurred to Dr. Christison, is in this respect interesting.

Charles Munn was tried at the January spring circuit, for the double crime of procuring abortion, and of murder by poisoning. The moral evidence and symptoms together, left no doubt that arsenic had been given, and that the deceased, a girl with whom the prisoner cohabited, had laboured under the effects of that poison in a very aggravated and complex form for twelve days. After that, she began to recover rapidly, and in the course of a fortnight, was free from every symptom except weakness and pains in the hands and feet:—in short, all things considered, she was thought to be out of danger. But she then became affected with headache and sleeplessness, and died in nineteen days more under symptoms of obscure general fever, without any local inflammation. The medical opinion given was, that granting the girl's first illness, as it appeared from moral and medical evidence, to be owing to arsenic, her death could not be ascribed to that poison with any certainty. (On poisons, p. 43.)

It will be seen from the facts above related, that a question of this kind can only be satisfactorily settled, by a reference to the particulars attending each case.

This question may sometimes present itself to the medical witness in another form, namely, whether a person has died from a medicine exhibited in an improper dose or from disease. Thus a person enfeebled by age or disease, may be killed by a powerful drastic purgative. Infants may be killed by small doses of calomel. Several lives have been already lost by the effects of frequently repeated doses of gamboge and aloes, exhibited in large quantities to enfeebled persons, under the form of Morison's pills, and convictions for manslaughter have taken place on this ground. The questions will be, 1. Whether the medicine or the disease caused death ; or, 2. Whether the medicine merely accelerated death. The amount of guilt will depend upon the answers : and it will be for a jury to consider whether there were sufficient knowledge and caution employed by the person prescribing it.

The most simple remedies, improperly used, may thus act like poisons and destroy life. Such cases are commonly too well marked, to admit of much difficulty in deciding as to the real cause of death.

3. DEATH MAY HAVE BEEN CAUSED BY VIOLENCE AND NOT BY POISON.

A person who has taken poison, may be maltreated, and the question will arise whether the poison or the maltreatment was the cause of death. The solution of this question cannot in general be very difficult, when the history of the case is before us. Two instances of this kind are recorded by Christison, both of them quoted from foreign authorities. He suggests, what is highly probable, that their real nature would not have been discovered in this country, owing to the very superficial way in which inquiries into the causes of death are here conducted :—the rule being not to call for a post-mortem examination of a body unless there be suspicion, when in point of fact in numerous instances the inspection may be the only source from which suspicion of violence will proceed ; and the very circumstance of holding an inquest implies something like suspicion as to the cause of death.

Wildberg was called upon to examine the body of a girl, who died while her father was chastising her for stealing. It was supposed by all, that the girl had died from the effects of the violence. On the arms, shoulders, and back, many marks of violent treatment were found, and under some of them, blood was extravasated in large quantity. The injuries, although severe, did not appear sufficient to account for the sudden death. He, therefore, proceeded to examine the cavities, and on opening the stomach, he found it very much inflamed and lined with a white powder, which was proved to be arsenic. It turned out that on the theft being detected, the girl had taken arsenic for fear of her father's anger: she vomited during the flogging, and died in slight convulsions. Upon this, Wildberg imputed death to the arsenic, and the man was exculpated.

A woman at Berlin, who lived on bad terms with her husband, went to bed in perfect health, but soon afterwards her mother found her breathing very hard, and on inquiring into the cause, discovered a wound on the left side of the breast. A surgeon was sent for, and the hæmorrhage, which was slight, was arrested: but the woman died towards morning. On an inspection, it was found that the wound had penetrated the pericardium without touching tho heart, and that the hæmorrhage had been caused by a division of one of the intercostal arteries; but very little blood was effused in the chest. Coupling these circumstances with the trifling loss of blood during life, and the fact that she had much vomiting and some convulsions immediately before death, it appeared to the medical examiner that she could not have died from the wound. The body was further inspected: signs of corrosion and irritation were found in the mouth, throat, and stomach, and the remains of some nitric acid were discovered in a glass in the room. The facts proved that she had died from poison. (p. 48.)

The cause of death may be easily assigned in such cases, where the circumstances are known ; but it is evident that without great care in conducting post-mortem examinations, the apparent may be sometimes mistaken for the real cause.

The kind of violence may sometimes sufficiently account for death without reference to the poison which may have been taken. The following remarkable case occurred at Walworth in 1836.

A young man was found hanging in his bed-room, quite dead. He was suspended by his cravat, and his feet were within an inch of the floor. The door of the room was fastened on the inside, and it was proved that no one could have had access to it. An earthen pan was found near the bed, containing about a pint of blood, which appeared to have proceeded from a very deep incision in the bend of the left arm of the deceased. The razor with which this had been inflicted, was found on the mantelpiece. It came out in evidence, that on the night previously, the deceased had swallowed a quantity of arsenic, and had suffered severely from the effects of the poison; although at the time, it was supposed that his illness was due to other causes.

In this case, there were three modes by which suicide was attempted. The deceased had first taken poison, then wounded, and afterwards hung himself. There could be no doubt that death was caused by hanging, and had the wound been inflicted, and the poison administered by other parties, this opinion might have been safely expressed. Had the body been found hanging in a suspicious locality, these circumstances might have created a strong presumption of murder.

The real cause of death may not always be so clear; for a severe wound, sufficient to account for death, may have been inflicted on the individual who has taken poison. A case occurred to Mr. Watson of Edinburgh, which may serve as an illustration.

A stout corpulent woman, aged 60, was brought into the Royal Infirmary, on the evening of the 7th February, 1838, having her throat extensively cut, and died shortly after admission. It was afterwards ascertained, that she had swallowed two ounces of sulphuric acid, a quarter of an hour before cutting her throat. After having taken the acid, she was seen writhing in great pain: she had then put a razor into her pocket, and left the house to cut her throat. She inflicted the incisions on arriving at the street, was immediately seen, and conveyed to the infirmary, which was close by. She died in about half an hour after taking the acid into the stomach. (Ed. M. & S. J., April, 1840.)

The wound in the throat was very deep, and besides other vessels, divided completely the internal jugular vein on the left side. At the inspection, there being no suspicion of poison, it was supposed that the hæmorrhage from the wound sufficiently accounted for death. On opening the abdomen, three-fourths of the stomach were wanting, its coats having been dissolved and decomposed by the action, as it was proved, of strong sulphuric acid. Whether this or the hæmorrhage was the cause of death, it was rather difficult to say; but probably the loss of blood, by weakening the system, accelerated the effect of the shock produced from the extensive disorganization of the stomach by a corrosive poison. Thus both causes may have operated, since it is unusual for sulphuric acid to destroy life within so short a period of time. I need hardly observe, that had the wound been inflicted by another, a most important question would have arisen as to the degree of criminality to be attached to the party who had inflicted it.

4. OF TWO POISONOUS SUBSTANCES TAKEN BY THE DECEASED, WHICH CAUSED DEATH?

This question does not relate so much to the subject of compound poisoning, as to cases of the following kind, which may require careful medical investigation. A person may have had poison administered, while labouring under the effects of powerful medicine, or of some other poison. Thus a patient, while under a course of mercury, may have had corrosive sublimate administered to him with intent to murder. After a certain period, violent salivation with sloughing may ensue, and the patient die. Is death in such a case to be ascribed to the corrosive sublimate, or to the mercurial medicine previously administered? It may be necessary to state that death is sometimes produced by the severe salivation, induced by the preparations of this metal prescribed medicinally, in a mild form and in small doses.

In Butterfield's case, tried at Croydon, many years ago. this question incidentally arose. The prisoner was. indicted for administering corrosive sublimate to the deceased. The immediate cause of death was profuse salivation; and this was referred by the medical witnesses, to the operation of the poison. It was proved, however, in the defence, that about two months previously to this attack, the deceased had been under treatment with some quack medicine, by which he was violently salivated ; but this salivation had entirely ceased, and during the whole of the above-mentioned period, he had abstained from taking any mercurial preparation. It was at this time that the corrosive sublimate was supposed to have been secretly administered to him in small doses. The prisoner, however, was acquitted of the charge on the ground, that as mercury had been introduced into the system of the deceased by the quack-medicine, the fatal salivation might have proceeded from a recurrent operation of this medicine, and not from the poison.

Sometimes the action of the two substances will be so entirely different, as to lead to no difficulty in determining which caused death.

At the Oxford Spring Assizes 1836, a woman named Tarver was indicted for the murder of her husband by poisoning him with arsenic. The evidence showed, that the deceased, who was a labourer, went to his work between four and five o'clock in the morning. In about ten minutes afterwards, he became very sick: he continued to become worse until about two o'clock on the same day, when he died nine hours after his first seizure. He suffered chiefly from a burning heat in the stomach and violent vomiting. Arsenic was traced to the possession of tho prisoner. It was proved that she had prepared breakfast for her husband on the morning on which be was seized; and that among other things, she gave him some rice-pudding. On opening his body, the stomach was found highly inflamed:—its surface covered with a grey sanguineous mucus, and at the pyloric extremity, there was a large patch of a deep mulberry colour. An analysis was made of the contents of the organ, and arsenic was discovered in them, in very large quantity.

The defence chiefly rested upon the following point. It was proved that *two days* before the deceased was attacked with this severe illness, he had, of his own accord, taken some pills made of scorched wood-laurel, nitre, and flour; and it was admitted by the medical witness, that wood-laurel was an acrid poison. He thought, however, that if this substance had acted as such, and had caused the death of the deceased, it would have begun to operate in ten or twelve hours at the farthest. But as the deceased was proved to have been quite well on the whole day after he took these pills, and that forty-eight hours elapsed before any alarming symptoms began, he thought they could havo had no connexion with the symptoms or death of the deceased. The symptoms, as well as the post-mortem appearances, proved that death had been caused by arsenic. The prisoner upon this evidence was convicted, and confessed before execution, that she had put arsenic in the pudding served for her husband's breakfast.

The correctness of the medical opinion in this case cannot be disputed. The operation of wood-laurel as a poison, even had it been administered in sufficient quantity to do mischief, (a fact not proved in evidence,) was not likely to be suspended for forty-eight hours, and then burst out with such severe symptoms, and destroy life in nine hours.

The following case is of some interest in relation to this question. A woman was found dead, and near her body was a glass containing some sulphuric acid. This gave rise to a suspicion of poisoning. On inspection, the mouth and fauces were covered with a black mucous matter, and the œsophagus was filled with a tarry-looking mass which had a strong acid reaction. The coats were softened and the lining membrane was easily detached. The stomach was throughout inflamed and of a brownish black colour: its coats were so softened that it could not be moved without lacerating it. It contained a large quantity of a black viscid liquid, which, as well as that in the œsophagus, was found to contain both arsenic and sulphuric acid. (Von Raimann, Med. Jahrb. 20 B. 2 S. 221.) Admitting that two poisons were taken in this case, which was taken first?—Most probably the arsenic. It is more difficult to say which caused death, because the deceased was not seen during life, and probably she was already labouring under the effects of arsenic when she swallowed the sulphuric acid. The fact of this last poison having been taken, appears to show that it was a case of suicide. But perhaps the sulphuric acid itself contained arsenic as impurity, as some specimens prepared from arsenical pyrites are found to contain a large quantity of that substance.

It is obvious that for the proper investigation of cases of this description the medical witness should be prepared with a full knowledge of the peculiar properties of most poisons—the doses in which they prove fatal—and the period of time within which they produce their symptoms and commonly destroy life.

CHAPTER X.

CONCLUDING REMARKS ON GENERAL POISONING.

The duty of a medical witness as such, is accomplished when he has proved on a charge of criminal poisoning, that death was *certainly* due to poison. The moral and circumstantial evidence must prove that the accused was the party who gave it;—this proof often fails,—the fact of administration cannot be brought home to the accused, and the case falls to the ground. It is not within the province of this work to treat of moral and circumstantial evidence in cases of poisoning. Proofs of this kind, it is true, are sometimes very closely mixed up with the evidence of professional witnesses, and in the foregoing chapters some of these have been already adverted to. A witness must, however, be cautious not to base his opinion in questions of poisoning on moral and circumstantial proofs. He is called upon to give a medical opinion of the cause of death, and from *medical* facts only. The moral and circumstantial proofs refer chiefly to the *administration* of poison by a particular party, and the *intent* of the person charged with the crime: —it is therefore considered to fall within the province of the jury alone to decide on their relevancy and value, although it must be confessed, that many of these facts can only be properly estimated by persons versed in medical science. Then, again, supposing death by poisoning to have been clearly proved, it may be necessary to discover whether the act was the result of accident, suicide, or homicide. This is a question also for a jury to determine, and not for a witness; although its solution often depends upon a proper appreciation of medical circumstances. Suicide or murder will sometimes be inferred, according to the medical evidence given of the effects of certain poisons. Some speedily annihilate volition and the power of locomotion, and therefore render it a question of serious difficulty, whether particular acts could have been performed after the deceased had taken the poison. On the answer to this may depend the acquittal or conviction of a person charged with the crime.

There is one peculiarity in the legal consequences of the act of killing by poison, namely, that the act itself is considered in law to be evidence of malice. If a poison be knowingly administered to another, and destroy life, the crime is said never to be reduced to manslaughter; whatever may have been the provocation which the party administering, may have received from the person whose life he has thus taken. It is not necessary, therefore, that any particular enmity should be proved to have existed between the prisoner and deceased, although this often weighs as a strong moral circumstance against the former. When a man is killed by a wound in a quarrel, the law will sometimes find an excuse for the act, from the heat and passionate excitement under which the aggressor was labouring at the time; but if the aggressor should avenge himself by administering poison to his adversary, there is no excuse for the act, since it evinces cool, reflecting, and deep-rooted malice. That death by poison should ever amount to manslaughter, therefore, it must be shown, that the substance was administered to or laid in the way of the deceased by mistake, or with innocent intention; and the proof of this always lies with the accused—the law inferring that malice exists until the contrary appears from the evidence. Whether malice exist or not, is, however, in general soon made evident from the statement for the prosecution.

There is one curious point in our law, namely, that in order to make the killing murder, it is necessary that the party should die from the effects of the poison, within *a year and a day* from the time at which it was taken. (Archbold's Criminal Pleading, 345.) In practice, this restriction is of little importance, because most cases of criminal poisoning, if they prove fatal at all, destroy life within a period much shorter than that required to constitute murder by the law. Still, such a rule as this ought not to be allowed to exist in any shape; because it is quite probable that death may take place from the indirect effects of poisoning, (as in the mineral acids,) long after the period assigned.

In this respect the laws of Scotland and France seem much more consistent with reason and justice. According to these, a prisoner may be held responsible, at whatever period death may ensue, provided death be clearly traced to the action of the poison.

The present state of the English law with regard to the crime of poisoning is as follows :—

The wilful administration of poison, followed by death, constitutes murder, and capital punishment is annexed to the crime by the common law of England.

Under a recent statute, 1 Vict. c. 85, s. 2, the administration of poison with *intent* to murder, if followed by *bodily injury dangerous to life*, though not by death, is also a capital felony.

By s. 3, of the same statute, the attempt to administer poison with intent to commit murder, although no bodily injury whatever ensue, is an offence liable to be punished by transportation or imprisonment.

In concluding this chapter, I wish to call the attention of the reader to some facts connected with the statistics of poisoning. In relation to medico-legal practice, this is a subject of some interest; because it will indicate to the medical jurist, what are the poisons that are most frequently selected for the purposes of suicide and murder, and with the properties of which, it will be expected that he should be acquainted. Unfortunately very few tables of this kind, have been published ; and those which have appeared are defective in many points. One of the best is that which was published some years since from the returns made by the coroners of England, of the number of inquisitions held in the years 1837 and 1838, wherein death was caused by poison.

The following is an abstract of the paper, which appeared in the Medical Gazette for November, 1839.

The number of deaths by poison (returned) in the two years above-mentioned, were 541, of which number 282 were males, and 259 females. The substances which caused death, may be taken in the following numerical order.

Opium				
Laudanum	133			
Opium	42			
Other preparations	21	196		
Arsenic		185		
Sulphuric acid		32		
Prussic acid		27		
Oxalic acid		19		
Corrosive sublimate and mercury		15		
Mixed or compound poisoning		14		
Oil of bitter almonds		4		
Poisonous mushrooms		4		
Colchicum, nux vomica (of each 3)		6		
Nitric acid, caustic alkali, tartar emetic, acet. morphia, strychnia, deadly nightshade, aconite, (of each 2)		14		
Bichrom. potash, nit. silver, Goulard's extract, sulph iron, mur. tin, hellebore, castor-oil seeds, savin, hemlock, cantharides, cayenne pepper, (of each 1)		11		
			527	
Unknown			14	
				541

It will be seen by this table, that the largest proportion of cases of poisoning in England, are those by opium and arsenic: the greater number of the former, being cases of suicide and accident, and of the latter, cases of criminal poisoning.

The two next are tables, the one of the statistics of poisoning in Denmark from the year 1830, to 1835 (Med. Gazette, January, 1840); the other of about an equal number of cases observed in France. (Journal de Chimie Méd. 1835.)

IN DENMARK.	
Sulphuric or nitric acid, generally diluted	74
Arsenic	16
Caustic alkalies	5
Opium	2
Litharge, verdigris, (of each 1)	2
	99

IN FRANCE.	
Arsenic	58
Verdigris	7
Corrosive sublimate	6
Cantharides	5
Nux vomica	4
Nitric acid	2
Sulphuric acid, acet. lead, carb. lead, sulph. zinc, tartar emetic, opium, (of each 1)	6
	88

It is difficult to compare these two tables with the preceding,—the number of observations being much fewer. Poisoning by arsenic is, however, proved by them to be very common. It is remarkable that the mineral acids should have caused so many deaths in the kingdom of Denmark, the proportion being no less than three-fourths of the whole number.

CHAPTER XI.

ON POISONING BY THE IRRITANTS. SULPHURIC ACID. SULPHATE OF INDIGO.

In treating of the poisons individually, it is my intention to follow with some slight modifications, the arrangement adopted by Dr. Christison. The irritants may be divided into three groups—the non-metallic—the metallic—and those of an organic nature, i. e. derived from the vegetable and animal kingdoms. The non-metallic irritants comprise the mineral acids, oxalic acid, the alkalies, and their salts. According to strict chemical views, the alkalies and their salts should be placed among the metallic irritants; but it will be, in many respects, convenient to consider them in the same group with the acids. Besides, although they certainly have metallic bases, the demonstration of the existence of the metal is never required at the hands of a chemical toxicologist, as in the case of the true metallic irritants. Among the mineral acids, we shall first speak of poisoning by sulphuric acid.

SULPHURIC ACID (OIL OF VITRIOL.)—This poison is met with in commerce in two states, either concentrated or diluted. The concentrated acid is a heavy oily-looking liquid, often of a brown colour: it has a strong sharp acid taste—it powerfully reddens vegetable colours, and corrodes and destroys most kinds of organic matter. It is very frequently taken as a poison by suicides; but probably there is no case in which the sufferings of the individual before death are more intense. In medico-legal practice, it is rare to find that this substance is employed for the purposes of murder. Young children have, however, been destroyed by a quantity of the acid being poured down the throat; and it is obvious, that a person who is drunk or asleep, may be thus killed. With these exceptions, which are of rare occurrence, instances of fatal poisoning by sulphuric acid may be pretty equally divided into cases of suicide and accident. The taking of this liquid is a very frequent form of self-destruction among females;—less frequent among males, and by no means uncommon as an accident among young children of both sexes. On the discovery of a dead body, poisoned by sulphuric acid, a medical jurist will have then specially to consider the age of the deceased. If it be a new-born child, or very young infant, the presumption is that the poison has been homicidally administered; if a child, all other circumstances being equal, that it has been swallowed by accident; if an adult, that it has been voluntarily taken for the purposes of suicide. It is to be observed, that there is no poison which can be obtained more readily or without exciting less suspicion than sulphuric acid, since it is used for so many domestic purposes.

The only probable case of murder by this poison in an adult, would be where the person was either intoxicated or asleep when the poison was administered; but even then the individual would be immediately roused. It is not easy to imagine that a criminal, who wished to destroy the life of another, would attempt this by causing him to swallow forcibly a quantity of oil of vitriol, when there are so many other more ready, secret, and speedy means of destruction at hand. It is also impossible that such a substance as this should, like arsenic, be secretly administered in articles of food. Its powerfully acid taste in the smallest quantity, not to mention that the physical qualities of the food would be entirely changed, must lead certainly to a discovery and frustrate the attempt. I have only met with one instance where such an attempt to poison was made. A boy being offended with his mistress, put a quantity of common diluted vitriol into a cup of tea, which she was about to drink. The taste of the tea immediately led to the discovery of the attempt.

SYMPTOMS.—When this poison is swallowed in a concentrated form, the symptoms produced come on *immediately* or in the act of swallowing, for it is one of the most powerful corrosives. There is violent burning pain extending through the fauces and œsophagus to the stomach—the pain is often so severe, that the body is bent—retching and vomiting supervene, the latter accompanied by the discharge of shreds of tough mucus and of a liquid of a dark coffee-ground colour, mixed with altered blood. The mouth is excoriated, the lining membrane white, but after a time acquiring a grey or brownish colour—

the cavity filled with a thick viscid sputa, rendering speaking and deglutition very difficult. Around the mouth and on the neck, may be found spots of a brown colour from the action of the acid on the skin. There is extreme difficulty of breathing, owing to the swelling and excoriation of the fauces and larynx;—and the least motion of the abdominal muscles is attended with increase of pain. The stomach is so irritable, that whatever is swallowed, is immediately ejected, and the vomiting is often violent and incessant. The vomited matters are acid, and if they fall on a limestone pavement there is effervescence, if on coloured articles of dress, the colour is sometimes altered or discharged:—on a black dress, the spots produced by the concentrated acid are brown, and remain moist. An attention to these circumstances may often lead to a suspicion of the real nature of the case where the facts are concealed. After a time, there is great exhaustion, accompanied by general weakness:—the pulse is quick and small; the skin cold and covered with a clammy sweat. There is generally great thirst with obstinate constipation of the bowels;—should any evacuations take place, they are commonly of a dark brown colour, almost black, arising from the admixture of altered blood. In some instances, there have been convulsive motions of the muscles, especially of those of the face and lips. The countenance is expressive of great anxiety, and the most dreadful suffering. The intellectual faculties are quite clear, and death usually takes place very suddenly, in from eighteen to twenty-four hours after the poison has been taken.

When the acid is diluted, the symptoms are much of the same character;—but less severe. The vomited matters are not so dark coloured—in one case, they were almost colourless. The spots produced by this acid on black cloth are red, becoming slowly brown.

The action of sulphuric acid on the fauces and œsophagus, is very energetic:—the lining membrane is stripped off in shreds, or peels off in large masses. In a case mentioned by Sobernheim, the lining membrane of the mouth, tongue and fauces, came off in one mass. In another related by Dr. Wilson, the patient, during a violent fit of coughing, brought up a large piece of sloughy membrane, which was found to consist of the inner coats of the œsophagus much thickened and very firm in texture. Its length was eight or nine inches, and its width that of the œsophagus—it was of a cylindrical form and pervious throughout its whole extent. (Med. Gaz. xiv. 489). This has been observed to occur in several other cases.

This poison may destroy life without reaching the stomach, a fact sometimes observed in the cases of young children. The larynx is then acted on:—the rima glottidis becomes closed by the swelling of the surrounding parts, and the child dies suffocated. In such cases, death takes place very rapidly. I have found that rabbits, to which this poison was given, died from this cause in the course of a few minutes. Mr. Quain met with the case of a child which died under these circumstances, when he was about to perform the operation of tracheotomy. On inspection, it was found that the acid had not even reached the œsophagus.

On the other hand, Ryland and Porter have remarked that in *suicide* by the sulphuric and other mineral acids, the larynx generally escapes injury. In their view, the epiglottis, during the act of swallowing, completely covers the upper part of the glottis, and thus the acid passes down the œsophagus without affecting the organisation of the larynx. When the acid has been swallowed by mistake, or when forcibly administered, the larynx is liable to be affected; for so soon as the mistake is discovered, which is almost immediately, all the muscles of the fauces and throat become spasmodically affected, and the fluid is ejected, partly by the mouth and partly by the nares; while, perhaps, a few drops pass at the same time into the glottis, causing inflammation and rendering tracheotomy necessary. When the poison is taken voluntarily, the mucous membrane, the mouth, pharynx, œsophagus, and stomach, will present the usual effects of the acid—i. e. marks of inflammation and corrosion. When the poison is taken by mistake, the parts chiefly injured are the mouth, pharynx, and epiglottis, and sometimes the lips of the glottis; and when forcibly administered to children, there will be symptoms of inflammation of the larynx accompanied by difficulty of swallowing. Death may take place, as was just now remarked, from this affection of the larynx alone; the acid may not even have reached the œsophagus. (See Ed. M. and S. Journ. xlix., 583; also Med. Chir. Rev. xxviii. 399.)

Thus, then, as a medico-legal fact of some importance, it is certain that *this poison may destroy life without reaching the stomach.* We cannot, however, say that the discovery of the effects of the poison in the stomach would indicate suicide; because in cases of murder, the stomach has been found disorganized by it, evidently showing that it must have penetrated thus far.

There is one case on record in which this poison has destroyed life, where it was injected into the rectum by mistake for a clyster. The patient suffered the most acute pain, and died in the course of a few hours. (Med. Gaz. xvii. 623.)

Can the symptoms produced by this poison cease and re-appear?—In general, it is observed that the symptoms continue increasing in severity until death, when the case is rapid:—but there may be remissions, and before death, the pain and suffering have been observed to become considerably abated. With this restriction, then, it appears to me the question should be answered in the negative. The following case, mentioned by Dr. Johnson, at a meeting of the Westminster Medical Society in October, 1836, is in this respect curious.

A person swallowed two ounces of concentrated sulphuric acid. After suffering from severe symptoms, the patient rallied and apparently recovered. A few days afterwards, during a severe fit of coughing, he brought up a quantity of the acid in its pure state:—the acid having been a fortnight in the stomach. It produced, in its passage upwards, fatal inflammation of the larynx. On inspection, it was ascertained that the acid had been surrounded by a cyst, formed by secretions from the stomach, which burst during the fit of coughing. This is a most extraordinary case, and so far as I know, unexampled in the history of poisoning. In explanation it has been suggested, that when concentrated sulphuric acid is dropped guttatim into albumen, a cyst of coagulum forms around the globules of acid and preserves the remainder from its action. This effect, however, is only temporary, and it will not satisfactorily account for a large quantity of the poison being swallowed and retained in the stomach for a fortnight. Among the *secondary* symptoms of poisoning by this acid, may be mentioned profuse salivation.

POST-MORTEM APPEARANCES.—It has been already remarked, that these are not always to be found in the stomach; they may be confined to the region of the fauces and larynx. In an inspection of the body, the whole course of the alimentary canal, from the mouth downwards, ought to be examined; since it is in the œsophagus and fauces that we obtain strong evidence of the action of a corrosive poison. The discovery of the usual marks of corrosion in these parts is always strongly corroborative of the signs of poisoning found in the stomach. In the inspection, the examiner must not omit to notice any spots on the skin produced by the action of the poison:—these are commonly of a dark brown colour, and are situated about the mouth and lips. The appearances met with in the body will vary according to whether death has taken place rapidly or slowly.

Supposing the case to have proved fatal within the usual period, the membrane lining the mouth is usually white, softened, and corroded. It is easily detached, and the parts beneath appear reddened. The mucous membrane of the fauces and œsophagus will be found in the same state, sometimes having a brownish or ash-grey colour. The corroded membrane of the œsophagus is disposed in longitudinal plicæ, portions of it being partly detached. The stomach, if not perforated, is found collapsed and contracted. On laying it open, the contents are commonly found of a dark brown or black colour, and of a tarry consistency, being formed in great part of mucus and altered blood. The contents may or may not be acid, according to the time the patient has survived, and whether or not any treatment has been adopted. On removing them, the stomach may be seen traversed by black striæ, or the whole of the mucous membrane may be corrugated and of a dark brown or black colour. This blackness is not removed by washing. On stretching the stomach, traces of inflammation may be found between the rugæ, indicated by a deep crimson colour. On removing the blackened membrane, the red colour indicative of inflammation, may be also seen in the parts beneath. Both the dark colour and marks of inflammation are sometimes partial, being confined to insulated portions of the mucous membrane.

The small intestines are found more or less inflamed; and their contents are of the same nature as those met with in the stomach. When the stomach is perforated, the coats are softened, and the edge of the aperture is commonly black and irregular. In removing the stomach, the aperture is apt to be made larger by the mere weight of the organ. The contents do not always escape; but when this happens, the surrounding viscera are attacked by the poison. In a case which occurred at Guy's Hospital, the spleen, the liver, and the coats of the aorta, were found blackened and corroded by the acid which had escaped through the perforation.

Dr. Craigie of Edinburgh thinks that even when there is no perforation of the stomach, the acid may find its way by transudation through the coats of the organ, in a very short time after it has been swallowed. In a case, where two ounces of the strong acid had been swallowed, and the person died in three hours and a half, he found that the peritoneum and the fluid contained in it reddened litmus paper strongly. There was also a slightly acid reaction even in the serous membranes of the thorax. It does not appear, however, that the nature of this acid was determined by the application of any test.

When the poison has been taken in a diluted state, the marks of inflammation on the mucous membrane are more decided, and the charring is not so considerable. Nevertheless, the acid acts upon and blackens the blood in the vessels, as well as that contained in the stomach.

When the individual does not die until after the lapse of eight or ten weeks, the mucous membrane of the œsophagus and stomach will be found entirely destroyed, and more or less extensively ulcerated. This leads to death by impairing the function of digestion. In several cases, the aperture of the pylorus has been found much contracted. Sometimes there will be stricture of the œsophagus. The common secondary causes of death in these cases, are fever, irritation, or exhaustion of the system.

It has been a disputed question, whether or not sulphuric acid is absorbed and carried into the circulation in cases of acute poisoning. M. Bouchardat considers, that it is absorbed, and that it causes death by leading to a coagulation of the blood in the heart, aorta and large blood-vessels. He has found these coagula in two cases in considerable quantity; and in one of these, the lining membrane of the aorta was reddened. I have observed this last-mentioned appearance in one case, as well as the occurrence of coagula in two instances; but there does not seem to be any reason for believing that they result from the action of a portion of sulphuric acid absorbed. In analysing these coagula taken from persons who have been killed by sulphuric acid, I have never found a trace of that acid present in them.

It might be said, that the acid was intimately combined with the albumen, and could not be separated from it by water; and that the use of iodic acid and starch, as recommended by M. Devergie (pòst, p 95) would alone detect the presence of the acid; but I must refer to what is said on the subject of this test to show that, in my opinion, it cannot be safely applied under these circumstances. Besides, it is well known that water will separate sulphuric acid from the compound which it forms with albumen.

Quantity required to destroy life.—The dangerous effects of this poison appear to arise more from its degree of concentration, than from the absolute quantity taken. The quantity actually required to prove fatal, must depend on many circumstances. If the stomach be full when it is swallowed, the action of the acid may be spent on the food and not on the stomach, and a larger quantity might thus be taken, than would suffice to destroy life if the stomach were empty. In one case, one drachm of sulphuric acid destroyed life in seven days :—in another (Humphreys, p. 36, antè), about one drachm and a half destroyed life in two days. In one instance, a patient survived fifty-five hours after taking three fluid ounces of the concentrated acid. (Dr. Sinclair, Med. Gaz. viii., 624.) In another instance related by Sobernheim, a man swallowed an ounce and a half of the concentrated acid, and yet slowly recovered from its effects. (Handbuch der Prakt. Tox. 384.)

In a case quoted by Dr. Craigie, a young woman aged eighteen recovered after having taken *two ounces* of concentrated sulphuric acid. She was completely restored in about eighteen days. (Ed. Med. and Surg. Jour., April 1840.) Another instance of recovery after two ounces of the concentrated acid had been taken, is reported by Mr. Orr. (Med. Gaz. iii., 255). The smallest quantity which I have been able to meet with as having proved fatal, was in the following case. Half a tea-spoonful of concentrated sulphuric acid was given to a child about a year old by mistake for castor-oil. The usual symptoms came on, with great disturbance of the respiratory functions, and the child died in twenty-four hours. The quantity here taken could not have exceeded *forty drops*. (Med. Gaz. xxix. 147). It is, however, doubtful, whether this small quantity would have proved fatal to an adult. The smallest fatal dose which Dr. Christison states he has found recorded was one drachm. It was taken, by mistake, by a stout young man, and killed him in seven days. (Op. cit. 125.)

Period at which death takes place.—It has been already stated, that the average period at which death takes place in cases of acute poisoning by sulphuric acid, is from eighteen to twenty-four hours. When the stomach is perforated by it, it proves more speedily fatal. In one instance, reported by Dr. Sinclair, a child about four years old died in four hours—the stomach was perforated. When the poison acts upon the larynx, death may be a still more speedy consequence from suffocation ; and it appears to be thus more rapidly fatal to children than adults.

Dr. Craigie mentions a case in which three ounces of concentrated sulphuric acid destroyed life in three hours and a half ; but the shortest case on record is, perhaps, that mentioned by Remer in Hufeland's Journal. In this instance, death took place *in two hours*. A case is reported by Mr. Watson, where a woman swallowed two ounces of the strong acid. She died in *half an hour*, but it appears that a quarter of an hour before death, she had made a deep wound in her throat, which gave rise to great hæmorrhage. The stomach was found very extensively perforated :—but it is highly probable that the wound accelerated death in this case.

On the other hand, there are numerous instances reported, in which the poison proved fatal from secondary causes, at periods varying from one week to several months. One of the best authenticated cases of this kind occurred within the last few years to Dr. Wilson of the Middlesex Hospital, and is referred to by Mayo in his Outlines of Pathology. A young woman swallowed about a table-spoonful of sulphuric acid on the 4th of January, and died from its effects on the œsophagus on the 14th of November following. She gradually wasted away and died from innutrition. This was forty-five weeks, or *eleven months*, after she had swallowed the poison. There is no doubt that the acid might prove fatal at periods much longer than this, but the longer it is protracted, the more difficult will it become to ascribe death to its effects.

Treatment.—Calcined magnesia, or the carbonate of magnesia, finely levigated and mixed with milk or water, should be exhibited as speedily as possible. In the absence of these, finely powdered chalk or whiting may be given. Some have recommended diluted alkali or a weak solution of wood ashes, or even common soap and water. Sobernheim and Simon relate several cases in which the individuals were apparently saved by the free use of these alkaline diluents. There is often great difficulty in making the patient swallow :—the throat being swollen and blocked up with shreds of tough mucus and sputa. To obviate this, the stomach-pump has been employed in order to inject the liquids into the stomach. The use of this instrument ought, however, if possible, to be avoided; since it is only likely to lacerate and perforate the structures which are softened and corroded by the acid. When there are symptoms of suffocation from an affection of the larynx, tracheotomy must be immediately resorted to.

On the whole, the antidotal treatment of cases of poisoning by sulphuric acid has not been very successful, the patient not being seen sufficiently early by a medical man to give much hope of success :—for it must be remembered, the poison begins to act instantly on contact; and if the stomach be at the time empty, there is but little hope of saving the patient. We often find these cases proving fatal even where every trace of poison has been removed from the stomach, owing to the extensive changes produced and the sympathy with remote organs.

That this antidotal treatment may, however, occasionally be the means of saving life, the following case, related by Barzellotti, will show.

A man aged 40 swallowed, by mistake, a quantity of the oil of vitriol, and was brought to the hospital of Santa Maria Nuova. He was suffering from intense burning pain in the throat and abdomen, as well as from other severe symptoms; calcined magnesia in water was given to him at short intervals, until it was supposed enough had been taken to neutralize the acid. A quantity of tepid water was then administered to promote vomiting; and, on examining the vomited matters, it was found that the sulphuric acid was neutralized by magnesia. The patient was then bled; leeches and fomentations were applied to the epigastrium, and demulcents exhibited. The man slowly recovered, suffering from difficulty of swallowing and severe cough. In one fit of coughing, he expelled a mass of false membrane, of the form and size of the œsophagus. The abdomen and throat were tender at the time of his discharge. (Questioni di Medicina Legale, ii. 307.)

It is to be observed, that cases of accidental poisoning like this, much more frequently do well than those of suicide—the quantity of poison swallowed being in general small.

The following case, which deserves to be here mentioned, was reported by Mr. Gardner to the Lancet, Aug. 25, 1838. A young man swallowed half an ounce of strong sulphuric acid. The usual symptoms appeared; milk and carbonate of magnesia were freely given. This person recovered in twelve days. One of the secondary symptoms was profuse salivation. It is worthy of remark, that several cases of recovery have taken place, where no chemical antidotes were administered. The treatment consisted simply in the exhibition of large quantities of gruel and milk; and there is no doubt, that any thick viscid liquid of this description, as, for example, linseed oil, must be beneficial, by combining with the acid and arresting its corrosive effects. In short, such a liquid would act much in the same way as the presence of a large quantity of food is known to act, when the acid is swallowed soon after a meal. In all cases, it would be advisable to combine the use of chemical antidotes, with the administration of mucilaginous drinks.

CHEMICAL ANALYSIS.—This acid may be met with either concentrated or diluted; and a medical jurist may have to examine it under three conditions:—1. In its simple state.—2. When mixed with organic matters, as with liquid articles of food or in the contents of the stomach.—3. On solid organic substances, as where the acid has been thrown or spilled on articles of dress or clothing.

In the simple state.—If *concentrated*, it possesses these properties:—1. A piece of wood or other organic matter plunged into it, is immediately carbonized or charred—2. When boiled with wood, copper cuttings, or mercury, it evolves fumes of sulphurous acid; this is immediately known by the odour, as well as by the acid vapour first rendering blue and then bleaching starch-paper dipped in a solution of iodic acid.—3. When mixed with an equal bulk of water, great heat is given out.

TESTS.—For the acid in the *diluted* state, but one test need be applied:—a solution of a salt of barytes,—the nitrate of barytes, or the chloride of barium. Having ascertained by test paper, that the liquid is acid, we add to a portion of it a few drops of nitric acid, and then a solution of nitrate of barytes. If sulphuric acid be present, a dense white precipitate of sulphate of barytes will fall down—which is insoluble in all acids and alkalies. If this precipitate be collected, dried and heated to redness in a small platina crucible with five or six parts of charcoal powder, it will, if a sulphate, be converted to the state of sulphuret. To determine this point, we add to the calcined residue, dilute muriatic acid, at the same time suspending over it, a slip of filtering paper moistened with a solution of acetate of lead. If the original precipitate were a sulphate, the vapour now evolved will be sulphuretted hydrogen, known by its odour, and by its turning the salt of lead to a brown colour.

The delicate action of this test is such that a solution containing not more than the 1-40,000th part by weight of sulphuric acid, is most readily precipitated by it. In the experiment, distilled water must be used, since all kinds of river and spring water are precipitated by the test. With regard to the reduction of the precipitate to the state of sulphuret by charcoal, I have found that one-half grain of the sulphate of barytes will yield satisfactory evidence; and a quarter of a grain will give traces of sulphur, although somewhat indistinct. This is equivalent to about one-fifth of a grain of common oil of vitriol. In cases of poisoning, however, we either find the acid in much larger proportion, or it is altogether absent.

Objections to the tests.—When any inference is drawn by a medical witness from the presence of a minute quantity, it might be fairly objected that some portion of sulphuric acid may have become accidentally introduced during the experiment. Thus the nitric acid used may have been contaminated with sulphuric acid;—or the wood charcoal may itself have contained some saline sulphates, which would lead to the production of an alkaline sulphuret. The purity of these substances should then be determined by separate experiments.

Again, too much nitric acid must not be added to the liquid before applying the test:—because the salt of barytes is insoluble in strong nitric acid, and a white precipitate therefore falls, although no sulphuric acid be present. The obvious remedy for this, is to dilute the liquid with water before performing the experiment; or if any doubt exist, afterwards—when any precipitated sulphate of barytes will be left, while any portion of nitrate will be re-dissolved.

But the question arises—Are there no other liquids liable to be precipitated by this test and lead thereby to a fallacious inference? Nitrate of barytes is precipitated by at least three other acids—namely, the sulphurous, selenic, and iodic. The last is not precipitated by the test if it be diluted, and the nitric acid be first added: therefore it can constitute no objection to the process here recommended. The two first form precipitates insoluble in nitric acid, exactly like the sulphuric acid. All objection on this ground is, however, removed by the fact, that sulphurous acid is immediately recognised by its odour of burning sulphur, and may be separated from any sulphuric acid mixed with it by simply boiling it:—and with respect to the selenic acid, the white precipitate formed by it, calcined with charcoal, does not evolve sulphuretted hydrogen, or act on a salt of lead like that formed by sulphuric acid. Besides, it is not probable that such substances as selenic and iodic acids should ever be met with in common life or find their way out of a chemical laboratory. The iodate and seleniate of barytes do not, like the sulphate, yield a sulphuret, when calcined with charcoal.

But there are other objections:—1. A solution of alum or any acid sulphate, might be erroneously pronounced to be free sulphuric acid; for alum would give all the re-actions here described. The answer to this objection is very simple; we must slowly evaporate a portion of the suspected liquid in a watch-glass—there will be a saline residue if it be a solution of alum, otherwise not: for sulphuric acid should be entirely dissipated by heat, or should leave only the faintest traces of sulphate of lead. 2. The quantity of free sulphuric acid present, might be erroneously estimated, in consequence of some simple medicinal sulphate (as Epsom salt) being mixed with it. This may be determined also by evaporation; and the free sulphuric acid separated by warming the liquid, and adding finely-powdered carbonate of barytes, until effervescence ceases. The precipitate formed would be sulphate of barytes and represent the free sulphuric acid present.

There is, however, another source of error: any acid mixed with a common sulphate employed in medicine might be mistaken for free sulphuric acid;—as, for example, a mixture of citric or acetic acid and sulphate of magnesia. This may always be suspected when any saline residue is left on evaporating the mixture. In such a case carbonate of barytes would not separate the free acid, for it might form a soluble barytic salt with the extraneous acid, and this, by reacting on the sulphate of magnesia, would precipitate the sulphuric acid of that salt, and thus lead to error. Several methods have been proposed to obviate this difficulty. The two following are perhaps the best. 1. Concentrate the acid liquid and sulphate by evaporation ; then mix it with its bulk of alcohol. This will dissolve the free acid and leave the sulphate which may be afterwards washed with alcohol until all traces of acidity are lost. The alcohol may now be distilled off in great part :—carbonate of potash being then added to produce an alkaline reaction. To this liquid, nitric acid in slight excess and nitrate of barytes may now be added; and if the free acid were the sulphuric, it will be known by the precipitation which follows. 2. Obtain by evaporation and calcination, the whole of the saline sulphate from a measured quantity of the liquid. Re-dissolve this in water, acidulated with nitric acid :—precipitate all the sulphuric acid of the salt by nitrate of barytes, then dry and weigh the sulphate thus procured. Next obtain from an equal quantity of the liquid before evaporation, the whole of the precipitate produced on adding to it the nitrate of barytes and nitric acid—dry it, weigh it, and compare its weight with that derived from the sulphate of the evaporated liquid. It is obvious, that if there be no free sulphuric acid present, the weights will be the same in the two cases :—but should there be any, its quantity will be indicated by the increased weight of the sulphate of barytes in the latter case. This may be regarded as an outline of the processes. There are some details omitted which will readily suggest themselves to the practical toxicologist.

In liquids containing organic matter.—If the sulphuric acid be mixed with such liquids as porter, coffee, or tea, the process for its detection is substantially the same, the liquid being rendered clear by filtration previously to adding the test. The sulphate of barytes, if mixed with organic matter, may be purified by boiling it in strong nitric acid ; but this is not commonly necessary, as the reduction of the precipitate by charcoal may be equally well performed with the impure, as with the pure sulphate. Some liquids generally contain sulphuric acid or a sulphate, such as vinegar and porter, but the acid is in very minute proportion ; therefore, if there be an abundant precipitate, there can be no doubt, cæteris paribus, that free sulphuric acid has been added to them. Should the liquid be thick and viscid like gruel, it may be diluted with water, and then boiled with the addition of a little acetic acid. For the action of the test, it is not necessary that the liquid should be absolutely clear, provided it be not so thick as to interfere with the precipitation of the sulphate of barytes. So far with regard to articles administered, or of which the administration has been attempted.

Vomited matters.—These will commonly be found highly acid, reddening litmus paper, and causing effervescence with carbonated alkalies: they may be diluted with water, boiled, filtered, and tested in the way above described. If the patient have been under treatment, these matters obtained from the stomach may have *no acid* reaction, either from the copious administration of water and abundant vomiting, or from an antidote having been used, such as magnesia. If on testing the neutral liquid, there be a precipitate, sulphuric acid can be present only in the state of sulphate:—if this precipitate be abundant, it cannot be due to the presence of minute traces of sulphates in the gastric and salivary secretions, but still it would be improper to infer from this chemical fact alone, that sulphuric acid has been swallowed, since it is well known that some saline sulphates, such as those of magnesia and soda, are often exhibited in large quantities medicinally ; and it might be fairly objected to this evidence, that the precipitate was due to one of these salts. The symptoms, as well as other circumstances, would here aid the witness in forming an opinion—chemistry alone might mislead him.

In examining any organic liquid which has no acid reaction, it must be remembered that there are many salts in common use, some of them being medicines, which precipitate the barytic test. These are—all the soluble carbonates, phosphates, borates, tartrates, and oxalates. It is to be observed, however, that not one of these substances is precipitated by the test, provided the liquid for analysis be diluted and acidulated with nitric acid before adding it. Should nitric acid produce any turbidness in an organic liquid, this may be again filtered and boiled before it is tested.

Contents of the Stomach. — When the patient survives, the analysis will of course be confined to the matters vomited. If the case prove fatal, we may be required to examine the contents of the stomach. Should these be acid and give a precipitate with the test, it may be said that the acidity was due to the acids naturally contained in the gastric secretions (the muriatic and acetic) which, however, are in very small proportion, or to some acid liquid, taken as medicine or otherwise before death; —the precipitation by the test might also be ascribed to the presence of some medicinal sulphate. If the contents were not acid, then the effect produced by the test might be ascribed to the latter circumstance alone. All objections of this kind are at once removed not merely by resorting to the processes already described, but by noting particularly the presence or absence of the usual changes produced by mineral acids in the stomach, œsophagus, and fauces. The chemist might decide from an analysis alone; but the medical jurist must take into his consideration the symptoms under which the deceased suffered, and the post-mortem appearances found in his body, before he ventures to form an opinion from the results of his experiments.

Supposing the contents to give no evidence of the presence of the acid, we must then boil the changed or decomposed portions of the stomach in water, filter, and apply the tests to the filtered liquid. But still no evidence of the presence of the poison may be obtained. Under these circumstances, it has been proposed by M. Devergie to heat the stomach to a high temperature in a retort, the beak of which is plunged into a mixture of iodic acid and starch. It is assumed that the non-discovery of the poison is due to its combination with the substance of the stomach in a way so intimate, that water cannot separate it. The application of heat therefore would, in the process above mentioned, lead to a decomposition of the sulphuric acid by the carbon of the animal matter, and its transformation to sulphurous acid. This would be immediately indicated by the production of the blue iodide of farina. There are some objections which appear to me to render this process unfit for medico-legal purposes. Iodic acid is liable to be decomposed by many substances very different in their nature, as sulphuretted hydrogen gas, morphia, gallic acid, sulphocyanate of potash and saliva, and it is not therefore safe to infer that the only deoxidizing agent in the distillation of the organic matter as above described, is the sulphurous acid, formed at the expense of the sulphuric acid, received ab extra, and combined with the tissues. Besides, the mucous membranes contain sulphur; and it is impossible to say but that this may be evolved, and give rise to error. The reaction is so extremely sensitive, that the very smallest portion of sulphurous acid will decompose iodic acid. Hence it appears to me, that a medical jurist, when he finds no sulphuric acid in the stomach by the usual process of boiling, should rather declare that there is none present, than give an affirmative opinion of the existence of infinitesimal traces from the performance of a hazardous experiment.

It is a medico-legal fact of considerable importance, that the contents of the stomach in cases of poisoning by sulphuric acid, are often entirely free from any traces of the poison, even where it has been swallowed in large quantity. The acid is not commonly found when the individual has been under treatment, when there has been considerable vomiting, aided by the drinking of water or other simple liquids, or when the person has survived for a long period. If the case has been under treatment, the acid is either wholly absent or neutralized by antidotes. In support of this view, I might quote many reported cases; but I prefer giving two which I have witnessed. A girl swallowed four or five ounces of diluted vitriol, and died in eighteen hours. No portion of the acid could be detected in the stomach; but she had vomited considerably, and the acid was easily proved to exist in the vomited matters, by examining a portion of the sheet of a bed which had become wetted by them. In another case, nearly two ounces of the concentrated acid were swallowed;—the patient died in twenty-five hours;—the stomach was most extensively acted on, and yet no trace of the acid could be discovered in the contents. The liquidity of the poison, and the facility with which it becomes mixed with other liquids, and ejected by vomiting, will readily furnish an explanation of this fact. In many cases of poisoning by sulphuric acid, therefore, a medical witness must be prepared to find, that chemical analysis will furnish only negative results.

If the stomach should be perforated, the contents will be found in the abdomen or perhaps in the lower part of the cavity of the pelvis:—they may be absorbed by clean wetted linen or sponge, and these may be afterwards digested in distilled water, and the solution examined in the way described.

On solid organic substances.—It sometimes happens in cases of poisoning, that sulphuric acid is spilled upon articles of clothing, such as cloth or linen, and here a medical jurist may succeed in detecting it, when every other source of chemical evidence fails. Again, sulphuric acid is often used for the purpose of seriously injuring a party, as by throwing it on the person, an offence which, when accompanied with bodily injury, renders the offender liable to a severe punishment. On such occasions, proof of the nature of the corrosive liquid is required; and this is easily obtained by a chemical examination of part of the dress. The process of analysis is very simple. The piece of cloth should be digested in a small quantity of distilled water at a gentle heat, whereby a brownish coloured liquid is commonly obtained on filtration. If sulphuric acid be present, the liquid will have a strong acid reaction, and produce the usual effects with the barytic test.

These spots on clothing are known in general, 1. By the cloth, if coloured, having its colour changed to red or brown; 2. If produced by the concentrated acid, by their remaining damp, or humid for a considerable period, the sulphuric being a very fixed acid, and absorbing water. That no objection may be offered to the result of an experiment of this kind, it is necessary that another part of the dress should be treated in the same way, to show that the sulphuric acid is not due to the presence of any sulphate in the dress. Many articles of clothing, it must be remembered, yield slight traces of sulphates, when boiled in water. In the attempted erasure of writing from paper by diluted sulphuric acid, the same proofs will detect the presence of it. All white organic substances, although not blackened by diluted sulphuric acid, become, when impregnated with it, immediately charred on exposure to a moderate heat.

I have ascertained by experiment, that sulphuric acid may be easily detected on articles of clothing after many years' exposure. In January, 1831, a small quantity of this acid was spilled on a black cloth dress: it has been exposed in an open jar to the air for upwards of *twelve years.* The cloth is changed to a deep brownish black colour; it is soft and yields to water a brownish coloured acid liquid, in which a large quantity of sulphuric acid is easily detected. In a case of poisoning, which occurred in 1832, the acid was partly spilled on a dress of printed cotton.—This has been likewise exposed for eleven years, and the organic fibre is completely corroded by the acid, and reduced to a kind of humid powder. From this substance, by the addition of water, a liquid is obtained, the acidity of which is due to the presence of sulphuric acid. These facts are of some interest, because it has been generally supposed, that the stains on clothing soon lose all traces of the acid, partly by decomposition in contact with organic matter, and partly by evaporation; but it is hereby evident, that such stains may in some instances be detected for a period of time much longer than is ever likely to be required in any medico-legal investigation.

In determining the presence of sulphuric acid in articles of clothing, I have found a modification of the iodic acid test extremely delicate and easy of application. The following is the way in which I have applied it: About half a grain of the article of dress, impregnated with sulphuric acid, was introduced into a short piece of glass tube, about one-eighth of an inch in diameter, and closed at one end. The stuff was then gently heated, and at the same time a piece of paper previously saturated with starch, and moistened with a drop of iodic acid, was brought near the mouth of the tube. The blue iodide of farina was immediately produced by the sulphurous acid formed at the expense of the sulphuric acid, locked up in the organic substance. There could be no objection to this mode of employing the test, if we procured, at the same time, negative results from experimenting on other portions of the cloth unstained by sulphuric acid. If not more delicate than the barytic test, it has the advantage of being more readily applicable.

Sulphate of indigo.—Cases of accidental poisoning by this substance have occurred. As the compound is nothing more than a solution of indigo in common sulphuric acid, the symptoms and post-mortem appearances are the same as those that have been described for the latter substance. This kind of poisoning may be suspected, when, with these symptoms, the membrane of the mouth has a blue colour. The vomited matters are also of a deep blue ; and in the case of a girl, who swallowed an ounce and died eleven hours afterwards, it was remarked that the urine which she passed, had a tinge of blue. After death the mucous membrane of the lower part of the intestinal canal presented patches of a blue colour. In another instance, observed by Orfila,—a child which died in seven and a half hours, the urine was also tinged blue.

The chemical analysis is the same as that described for sulphuric acid in organic mixtures. The blue colour of the sulphate is immediately destroyed by boiling it with nitric acid. The barytic test may then be employed in the usual way.

Quantitative analysis.—It may be sometimes necessary to state how much sulphuric acid is present in a particular liquid. In order to determine this point, a portion of the liquid may be measured off, and the whole of the sulphuric acid present may be precipitated by the salt of barytes. The sulphate of barytes should be rendered pure by boiling it in nitric acid, then washed, dried, and weighed. For every one hundred grains of dried sulphate obtained, we must allow about forty-one and a-half grains of common oil of vitriol to have been present ; and so on in the same proportion for any other quantity. If we thus obtain the weight of the sulphuric acid present, it is very easy, from its known specific gravity, to calculate the quantity by measure.

CHAPTER XII.

POISONING BY NITRIC ACID. (AQUA FORTIS.)

This substance is popularly known under the name of aqua fortis, or red spirit of nitre. According to Tartra, it seems to have been first used as a poison about the middle of the fifteenth century. Although, it is perhaps, much more used in the arts than oil of vitriol, cases of poisoning by it, are by no means so common. Tartra was only able to collect fifty-six cases extending over a period of nearly four hundred years; and it appears from the return of inquisitions for 1837-8, there were only two instances reported to have occurred in England during those two years. Cases of poisoning by this acid have chiefly been the result of accident and suicide. I have only met with one instance where it was poured down the throat of a child for the purpose of murder. It is obvious that this acid may be used by a murderer, under the same circumstances as those enumerated in speaking of sulphuric acid. The external application of nitric acid has been a criminal cause of death on several occasions:—in one instance the acid was poured into the ear of a person while sleeping, and it led to the slow destruction of life. These are not strictly cases of poisoning, but more nearly approximate to death from wounding or mechanical violence. They will, therefore, be considered hereafter.

Symptoms.—These, on the whole, bear a close analogy to those produced by sulphuric acid. They come on *immediately*, and the swallowing of the acid is accompanied by the most intense burning pain in the fauces and œsophagus, extending to the stomach:—there are gaseous eructations from the chemical action of the poison,—swelling of the abdomen, violent vomiting of liquid or solid matters, mixed with altered blood and shreds of mucus, having a strong acid reaction. The abdomen is generally exquisitely tender; but in one well-marked case of poisoning by this acid, the pain was chiefly confined to the fauces. The mucous membrane of the mouth is commonly soft and white, after a time becoming yellow, or even brown; the teeth are also white, and the enamel is partially destroyed by the chemical action of the acid. There is great difficulty of speaking, as well as of deglutition; the power of swallowing is sometimes entirely lost. On opening the mouth, the tongue may be found swollen and of a citron colour, the tonsils are also swollen and enlarged. The difficulty of respiration is sometimes such, as to render tracheotomy indispensable, especially in young subjects. (Case by Mr. Arnott, Med. Gaz. xii. 220.) As the case proceeds, the pulse becomes small, frequent, and irregular; the surface of the body extremely cold, and there are frequent rigors. The administration of remedies—the deglutition of the smallest quantity of liquid increases the severity of the pain, and gives rise to a feeling of laceration or corrosion. (Tartra, 144.) There is obstinate constipation. Death takes place in from eighteen to twenty-four hours, and is sometimes preceded by a kind of stupor easily removed. The intellectual faculties commonly remain clear until the last.

Death may be occasioned by this acid, in consequence of its effect on the larynx, as in the case of sulphuric acid.

Should the patient survive the first effects of the poison, the mucous membrane of the fauces and œsophagus is discharged either in irregular masses or there may be a complete cylinder of the œsophageal lining. There is great irritability of the stomach, vomiting and destruction of the powers of digestion: the patient becomes slowly emaciated, and dies from starvation or from exhaustion.

Post-mortem appearances.—The best account of these will be found in the well-known work of Tartra, (Traité de l'Empoisonnement par l'Acide Nitrique,) published upwards of forty years ago.

Supposing death to have taken place rapidly, the following appearances will be met with. The skin of the mouth and lips will present various shades of colour from an orange yellow to a brown; it appears like the skin after a blister or burn, and is easily detached from the subjacent parts. Yellow spots produced by the spilling of the acid may be found about the hands and neck. A yellow frothy liquid escapes from the nose and mouth, and the abdomen is often much distended.

The membrane lining the mouth is sometimes white, at others of a citron colour, the teeth are white, but present a yellowish colour about the coronæ. The pharynx and larynx are much inflamed; the latter sometimes œdematous. The lining membrane of the œsophagus is softened, and of a yellow or brown colour, easily detached, often in long folds. The trachea is more vascular and the lungs are congested. The most strongly marked changes are seen in the stomach. When not perforated, this organ may be found distended with gas—its mucous membrane partially inflamed with patches of a yellow, brown, or green colour, or even black. This green colour is due to the action of the acid on the bile; but it must be remembered that a morbid state of the bile itself often gives this appearance to the mucous membrane in many cases of death from natural disease. There is occasionally inflammation of the peritoneum, and the stomach is glued to the surrounding organs. Its coats are often so much softened, as to break down under the slightest pressure. The duodenum sometimes presents similar changes; but in some cases, the small intestines have presented no other appearance than that of slight vascularity.

It might be supposed that the stomach would be in general perforated by this very corrosive substance; but that is far from being the case. Tartra only met with two instances, and in one of these, the individual survived twenty, and in the other thirty hours. In giving this poison to rabbits, I have not found the stomach perforated, although the acid had evidently reached that organ. In these cases the non-perforation appeared to be due to the protective influence of the food with which the stomach was distended. In the few cases that are reported in English journals, it would appear that the stomach has not been perforated: the poison had been swallowed soon after a meal, and its parietes thus escaped the corrosive action of the acid.

In cases of chronic poisoning, i. e. where death takes place slowly, the appearances are of course very different, as the following case will show. A man, aged thirty-four, swallowed a wine-glassful of nitric acid, but the greater portion was immediately rejected by vomiting. An attack of acute gastritis followed, which was combated by the usual remedies. The man was discharged from the hospital into which he had been admitted in three weeks; but about a month afterwards, he was readmitted in consequence of his suffering severe pain throughout the œsophagus to the epigastrium, as well as from vomiting after taking food. The patient gradually sank, and died three months after he had taken the acid. On dissection the pylorus was found so diminished in size, that its diameter did not exceed a line or two, and the duodenum was equally contracted for about an inch and a-half from its commencement. The mucous membrane was softened and red in patches; and there were several cicatrices of ulcers. The subjacent tissues were in a schirrous state. (See Med. Chir. Rev. vol. xxviii. 553.)

As a contrast to this, we may here state the appearances met with in a case of poisoning by nitric acid, which proved rapidly fatal. A man swallowed about two ounces of aqua fortis, and died speedily from its effects. On examining the body, the lips were found partly yellow and partly of a brownish red colour, dried up like parchment. Several yellow or parchment-coloured spots, were found on the chin, as also on the cravat. The mucous membrane of the mouth was white and easily detached,—that of the tongue was dry and hard,—that of the pharynx and œsophagus yellowish green in colour and of a leathery consistency. The stomach contained a dark coloured liquid, highly acid. It was externally mottled of a greenish blue and black colour. The mucous membrane throughout was softened, and in a gangrenous state. The same appearances were met with, although in a less degree, in the duodenum and upper part of the ileum. On analysis, the contents of the stomach yielded nitric acid. (Von Raimann Medicinisch. Jahrb. 20 B. 2 S., p. 221.)

Quantity required to destroy life.—The remarks made on this subject in speaking of sulphuric acid, apply here. Tartra states, that the quantity usually taken varies from one or two drachms to four ounces, never more than this; but in most of the cases which he reports, the quantity taken is not mentioned. Indeed, the obtaining of any information of this kind is purely accidental; and the determination of the exact quantity swallowed, must be therefore very difficult. One point is certain;—the same quantity will not kill two individuals in the same time,—one may die slowly, and the other rapidly, according to whether the stomach should happen at the time to contain food or not. The smallest quantity which I find reported to have destroyed life, is about two drachms. It was in the case of a boy, aged thirteen: he died in about thirty-six hours. But less than this, even one drachm, would doubtless suffice to kill a child; and under certain circumstances, an adult; for the fatal result depends on the extent of the mischief produced by this corrosive poison in the larynx, œsophagus and stomach. What is the largest dose from the effects of which a person has recovered, it is difficult to say; since in the cases of recovery mentioned by authors, the quantity of the poison taken, was unknown.

Period at which death takes place.—This must depend on the quantity swallowed, the strength of the acid, and whether or not any remedial treatment may have been adopted. Out of twenty-seven deaths from nitric acid, reported by Tartra, in nineteen it destroyed life rapidly, and in eight slowly. This author met with two instances in which death took place within *six* hours after the poison was swallowed; but he considers that the greater number who fall victims to the direct effects of the poison, die within twenty-four hours. Sobernheim relates a case of poisoning by nitric acid, which proved fatal in *one hour and three quarters.* (Op. cit. 402.) This I believe to be the most rapidly fatal case on record, where the acid acted as a poison. The usual well-marked effects were found in the œsophagus, stomach and duodenum. In young infants, however, life may be destroyed by this poison in a few minutes, should it happen to affect the larynx. A woman shortly after her delivery, in the absence of her attendants, poured a quantity of nitric acid into the mouth of her young infant. The mother concealed from those about her this attempt at murder; but medical assistance was immediately sent for. The child died in a *few minutes.* Some of the acid had been spilled; and from the yellow colour of the stains, the medical man suspected that the child had been poisoned by aqua fortis. On inspection, nitric acid was found in its stomach, and the mother confessed the crime. (Cazauvieilh Du Suicide et de l'Aliénation Mentale, p. 274.) Although in this case no mention is made of the state of the fauces and larynx, it is highly probable, from the rapidity with which death took place, that this event was in great part due to suffocation. The following experiment will perhaps serve to show how speedily life may be destroyed under these circumstances. Half a drachm of concentrated nitric acid was given to a rabbit. In about half a minute, it became insensible, and apparently lifeless. There was no sign of pain or irritation. It died in *one minute.* A small quantity of gaseous matter, in the form of a fuming vapour, escaped from the nostrils. The abdomen became much swollen. On inspection, it was found that the poison had strongly acted on and corroded the parts about the larynx. A portion had penetrated into the lungs, turning them yellow, and corroding them. Another portion had been swallowed, and had entered the stomach, producing the usual yellow stains, but it had not perforated the organ.

With regard to the longest period at which death has taken place from the effects of this poison, a case has been already related, where a man who had swallowed nearly two ounces, did not die until three months afterwards. The longest case is perhaps that recorded by Tartra, where a woman perished from exhaustion, produced by the secondary effects of the poison, *eight months* after having swallowed it.

TREATMENT.—It may be the same as that recommended in poisoning by sulphuric acid. In addition to the remedies there suggested, a diluted solution of carbonate of soda with barley-water, and other demulcents, may be administered. In many cases, there is an utter impossibility of swallowing even the smallest quantities of liquid: and if an attempt be made to introduce these remedies by a tube, there is great risk of perforating the softened parietes of the pharynx, larynx, or œsophagus. Should suffocation be threatened, then tracheotomy may be resorted to. Modern experience is rather against the recovery of these cases, under any form of treatment:—but according to Tartra, in accidental poisoning by this acid, there is very great hope of recovery, if the case be timely attended to. He states that out of thirty-one such cases, twenty-three recovered, seventeen perfectly; while out of twenty-four cases, wherein suicide was attempted, only six recovered. (Op. cit. p. 186.)

CHEMICAL ANALYSIS.—*In the simple state.* This acid may be met with either concentrated or diluted. The *concentrated acid* varies in colour from a deep orange red to a light straw yellow. It may be recognised,—1. By evolving acid fumes when exposed.—2 By its staining organic matter yellow or brown, the colour being heightened and turned more of a red tint by contact with ammonia.—3. When mixed with a few copper cuttings, it is rapidly decomposed—a deep red acid vapour is given off, and a greenish coloured solution of nitrate of copper is formed. Tin or mercury may be substituted for copper in this experiment.

TESTS.—In the *diluted* state. This acid is not precipitated like the sulphuric by any common reagent, since all its alkaline combinations are soluble in water.—1. The liquid has a highly acid reaction, and on boiling it with some copper turnings, red fumes of nitrous acid vapour are given off, unless the proportion of water be very great. At the same time, the liquid acquires a blue colour.—2. A streak made on white paper with the diluted acid, does not carbonize it when heated; but a scarcely visible yellow stain is left.—3. The liquid is neither precipitated by nitrate of barytes nor by nitrate of silver. These two last experiments give merely negative results—they serve to show that the sulphuric and muriatic acids are absent.—4. By dipping a piece of bibulous paper in a weak solution of potash, and then in a portion of the acid liquid and drying it—it will be found, on igniting it, if the acid were the nitric, that the paper burns with deflagration. This is not a property peculiar to nitric acid; but it distinguishes it from any of the common acids used as poisons. The chlorates, bromates, iodates, permanganates, and bichromates, burn with deflagration in contact with organic matter. I have also observed this with respect to one metallic oxalate—the oxalate of silver.

In order to detect nitric acid, the liquid should be carefully neutralized by potash. This should then be evaporated slowly to obtain crystals. If the liquid was nitric acid, these crystals possess the following characters.—1. They appear in the form of lengthened fluted prisms, which neither effloresce nor deliquesce on exposure. This character distinguishes the *nitrate* of potash from a very large number of salts.—2. When reduced to a fine powder and heated with their bulk of finely-powdered charcoal on platina foil, the mass suddenly ignites and burns with the well-known phenomena of deflagration. There are other salts that possess this property when heated with charcoal (suprà.)—3. When moistened with strong sulphuric acid, the powdered crystals slowly evolve a colourless acid vapour. By this test, the nitrate is known from every other deflagrating salt —4. A portion of the powdered crystals should be placed in a small tube and mixed with their bulk of fine copper filings. The mass is then to be moistened with water, and a few drops of strong sulphuric acid added. Either with or without the application of a gentle heat, a decomposition immediately ensues, by which the red fumes of nitrous acid are evolved, recognizable by their colour, odour, and acid reaction. This test answers equally well with a saturated solution of the salt in water

This last test is conclusive, and renders it unnecessary to resort to any other experiment. It is so delicate that, by using a tube only one-eighth of an inch in the bore, one-tenth of a grain of nitrate of potash will give satisfactory results. This is equivalent to about one-twentieth of a grain of nitric acid—a quantity to which the toxicologist will not often have to confine his analysis in medico-legal practice. Many other tests have been proposed for the detection of nitric acid as a nitrate.—1. The boiling of the suspected liquid with a small quantity of sulphate of indigo, when if nitric acid or a nitrate be present, the colour is discharged. This is not a very delicate test.—2. The boiling of the suspected nitric acid or solution of nitrate, with a few drops of muriatic acid and gold leaf, when the gold will become dissolved, a fact made evident, if not by the entire disappearance of the metal, by adding to the liquid a solution of protochloride of tin. This is a very satisfactory test.—3. Add to the liquid, a crystal of green sulphate of iron; if nitric acid be present, a dark green liquid is formed around the crystal as it dissolves:—if the solution be suspected to contain a nitrate, a few drops of sulphuric acid must be added, when the same effects will follow.—4. Add to the suspected salt in powder, a few grains of morphia and some strong sulphuric acid:—if it be a nitrate, the saline mass acquires an orange or a yellow-brown colour from the action of the evolved nitric acid on the morphia (O'Shaughnessy). This last test appears to me to be objectionable:—much of the morphia, in common use, acquires a slight colour from contact with sulphuric acid only; and the results are certainly not so uniform or satisfactory as those obtained by the action of sulphuric acid and copper filings.

Objections.—I know of no objections which can be urged to the mode of testing for nitric acid above recommended. The test of deflagration is merely one of a series of characters, and cannot of itself furnish evidence of the presence of a nitrate. It may be regarded simply as a trial-test. With respect to the action of copper filings and sulphuric acid, there is no salt of potash but the nitrate (that which is compounded of nitric acid) which gives such results as have been described. The bromide of potassium gives off ruddy vapours, somewhat resembling those of nitrous acid; but these bleach litmus paper; and are in other respects easily distinguishable. Besides, these ruddy vapours are given off from the solid bromide by sulphuric acid without the addition of copper filings, whereas a nitrate under similar circumstances yields a colourless acid vapour. It may be safely affirmed, that bromine could not be mistaken for nitrous acid vapour, by one who has been at all accustomed to chemical analysis.

In liquids containing organic matter.—Nitric acid may be administered in such liquids as vinegar or porter. In this case, besides the acid reaction, there will be the peculiar smell produced by nitric acid, when mixed with substances of an organic nature. The application of the usual tests is here counteracted:—thus unless the quantity of nitric acid in such a liquid as porter be very considerable, the orange red fumes of nitrous acid are not evolved on boiling that liquid with copper-cuttings. If the liquid be viscid, this viscidity must be destroyed by dilution with water:—and in all cases, if any solid or insoluble matters are floating in it, as in the *vomited matters* or *contents of the stomach*, it must be filtered, in order to obtain at least a portion of the acid liquid. This operation is commonly very slow.

If we procure the clear acid liquid, the colour may be disregarded. We should then carefully neutralize it with a weak solution of potash, or its carbonate; and boil it with a large quantity of well-washed animal charcoal for two hours. On filtration, it will probably come through of a pale yellow colour. If the colour should be at all deep, it must be reboiled with a fresh quantity of animal charcoal, and now on filtration it will be tolerably clear. Concentrate to a small bulk by evaporation. As a trial test we may dip in a slip of bibulous paper, dry it, and observe whether it burns with deflagration. This commonly answers, unless the quantity of nitric acid present be very small, or unless the nitrate of potash formed, be mixed with a large portion of some other salt. A portion of the liquid may then be crystallized on a piece of glass, by slow evaporation; and the resulting crystals examined for all those properties which have been described as characteristic of the compound of potash with nitric acid. The crystals obtained, may be coloured and impure. I have found that this circumstance does not at all interfere with the action of the most important test for nitric acid, namely, that by copper-filings and sulphuric acid. They may, however, if necessary, be purified by digesting them in pure ether, and pure alcohol. These liquids do not dissolve the nitrate of potash; but will often serve to remove from it the organic matters by which it is coloured. This process, according to my observation, is very effectual in detecting nitric acid, when mixed with liquids resembling porter.

If the acid has been administered in vinegar, acetate of potash is formed during the neutralization as well as nitrate. The acetate may be separated by pure alcohol, in which it is very soluble, while the nitrate remains undissolved. Other modifications will suggest themselves, according to the nature of the liquid, with which the acid is mixed.

But the vomited matters and contents of the stomach may have no acid reaction, and yet nitric acid may be present. Thus it may have become neutralized by lime or magnesia, through the administration of antidotes. In such a case, it would not be easily detected, unless it were in pretty large quantity. By the addition of carbonate of potash to the filtered neutral liquid, these earthy nitrates may be transformed to nitre, and the analysis then proceeded with,—the carbonates of lime and magnesia formed, being separated by filtration.

Again, for the same reasons as those mentioned in speaking of sulphuric acid, the liquid found in the stomach of a person who has died from nitric acid, may not contain a trace of the poison, either free or combined. Its absence, therefore, does not negative a charge of poisoning. Nitric acid has a much stronger tendency than the sulphuric to combine with the solid organic tissues; and in decomposing them, it undergoes decomposition itself. In a case of this kind, those parts of the mucous membrane, whether of the œsophagus or stomach, which are stained yellow or corroded, should be boiled in water, rendered alkaline by potash.

The resulting liquid may then be examined for nitre. This experiment, from the small quantity of free acid present, is very likely to fail. In examining the stomachs of rabbits killed by nitric acid, I have found that even deeply stained portions of mucous membrane have yielded commonly only very faint traces of acid. But the discovery of no more than traces of acid in cases of poisoning, is, in my opinion, tantamount to a failure of the chemical branch of evidence; for no inference could be drawn from such minute results relative to the fact of poisoning, unless the evidence from symptoms and post-mortem appearances, with moral circumstances, were sufficiently conclusive; and when this is the case, whether the poison be wholly absent, or exist only in infinitesimal traces, must be a matter of trifling importance. It has been said with great truth and propriety by Sobernheim and Simon, that in all medico-legal analyses of the acids and alkalies, if we except oxalic acid, the discovery of only a small quantity of the suspected substance, furnishes no proof of poisoning; unless this is placed beyond all doubt by other circumstances. (Handbuch der Prak. Tox. 404.) In such a case, it is obvious that this sort of proof is unnecessary. It may perhaps be proper to mention in this place, that the nitrates have not been found to exist as natural constituents of the secretions of the alimentary canal.

On solid organic substances.—We have already spoken of the modification required in the analysis, in reference to the supposed presence of the poison in the discoloured or corroded portions of mucous membrane. This acid is, however, sometimes maliciously thrown at persons; and we may be required to examine some article of dress, suspected to have been stained by it. The spots produced by strong nitric acid on woollen stuffs, are either of a yellow, orange red, or a brown colour, according to the time at which they are seen. On black cloth they are at first of a light brown colour, passing after eight or ten days to an olive green with a red border. After a time, they become dry, (unlike those produced by strong sulphuric acid,) and the texture of the cloth is entirely destroyed. In order to examine them, the stained portions may be cut out and digested in a small quantity of warm distilled water. If nitric acid be still present, the water will acquire an acid reaction; but to establish this, the liquor must be neutralized by potash, then evaporated and examined for nitrate of potash in the way already described. Should the water acquire no acid reaction, then there is no perceptible quantity of acid present. To render this certain, however, the water may be made feebly alkaline by potash, and again boiled with the stuff; the liquid may be filtered and examined for nitre. It is rare, that any evidence of the presence of nitric acid is obtained by this latter process, when the stained portions of cloth did not give out any free acid to the distilled water in the first instance. Should any traces of nitric acid be perceived in an experiment of this kind, an unattacked portion of cloth or stuff must be examined, before we can draw the inference that nitric acid had been spilled or thrown on it. On these occasions we may often be disappointed in searching for chemical evidence of nitric acid. Not to mention that the acid may be easily removed by washing while the stain remains, we must remember that it is volatile, easily decomposed, and its nature is entirely changed by contact with organic matter. These facts will explain to us, why after a few weeks the chemical evidence of the presence of this acid will sometimes be entirely lost; while in the case of sulphuric acid, the stains may furnish abundant evidence of its presence after many years' exposure. In all cases of the suspected throwing of nitric acid, the spots on the dress should be examined as soon as possible, or the chemical analysis will fail. The following case occurred lately at Guy's hospital: A man had some strong nitric acid maliciously thrown in his face, and the sight of one eye was thereby entirely destroyed. He wore at the time a blue stuff coat, which was not sent to be examined until *five weeks* after the accident, and only a few days before the trial of the prisoner for the offence. The sleeve and body of the coat were found to be covered with numerous spots of a yellowish brown colour. The spots were quite dry; they had evidently been caused by the action of some corrosive acid. The colour was discharged, and the fibre of the stuff corroded. Not a trace of nitric acid could be detected in them, although there was no doubt that it had been used. Its disappearance was probably due partly to its decomposition in the stuff, and partly to its volatility. Had the coat been examined soon after the offence, the nature of the acid would have been easily determined.

I have been able to procure certain evidence of the presence of nitric acid in stains on black cloth, a fortnight after the liquid had been spilled. The quantity of acid present was so small, that on adding to the filtered liquid, gold leaf and muriatic acid, there was no apparent solution of the metal, nor on trying another portion with sulphate of indigo was the colour discharged. A third portion of the acid liquid was neutralized by carbonate of potash, and evaporated, when crystals of nitre (amounting to about a grain) were obtained. These readily gave, with copper filings and sulphuric acid, the characters of a nitrate. There was but a thin slip of cloth used in the experiment.

In conducting an analysis of this kind, it has been recommended, when we obtain an acid liquid, to test it with the nitrate of barytes and nitrate of silver. The liquid, if it contain nitric acid only, should give negative results; but there are few specimens of clothes which do not yield traces of sulphuric and muriatic acids or of sulphates and muriates or chlorides, so that nitric acid may be still present when one or the other of these tests is affected.

QUANTITATIVE ANALYSIS.—Convert the nitric acid, contained in a measured quantity of the liquid, to nitre in the way above described. Convert the whole quantity of nitre thus obtained to sulphate of potash by the cautious addition of strong sulphuric acid. Dissolve this salt in water, and evaporate to dryness. Calcine the residue, and afterwards wash it with alcohol, to remove if necessary any portion of free sulphuric acid. For every one hundred grains of dry sulphate of potash thus obtained, we may estimate that there were present in the measured quantity of liquid, about eighty-two grains of liquid nitric acid, (aqua fortis)—the bulk of which, by measure, may be easily determined by calculation. Should the dried sulphate be very acid, it may be necessary to moisten it with a solution of sesquicarbonate of ammonia, and re-expose it to heat, to drive off the volatile alkali with the surplus sulphuric acid. Sulphate of potash, it must be remembered, is a perfectly neutral salt.

CHAPTER XIII.

POISONING BY MURIATIC ACID. (SPIRIT OF SALT.)

But very little is known concerning the action of muriatic or hydrochloric acid as a poison. That this form of poisoning is not very common, may be inferred from the fact, that Orfila has reported only one case, communicated to him by De Serres, in his large work on Toxicology. In the coroners' report for England, during the years 1837-8, out of five hundred and twenty-seven cases of poisoning, there was not one in which this acid was the poison used. I have been able to collect the reports of only *three* cases of poisoning by muriatic acid that have occurred in this metropolis, during a period of thirteen years. From this statement, it will be seen that the medico-legal history of this kind of poisoning must be very incomplete.

Symptoms.—From the few imperfect reports that have yet appeared, the symptoms produced by this acid do not differ widely from those caused by the two other mineral acids, described in the preceding chapters. There is the same sensation of burning heat extending from the throat to the epigastrium, with vomiting of a highly acid liquid of a dark green colour, mixed with mucus and altered blood. The tongue becomes swollen and dry; and with much thirst, there is great difficulty of deglutition. The tonsils and throat are inflamed. It is said, that there is an escape of acrid pungent vapours from the mouth, when the acid is first swallowed (Orfila); but this does not seem to have been observed in any of the reported English cases. In two instances, neither the vomiting nor pain in the abdomen was urgent, although both terminated fatally. The chief seat of pain was in the throat and fauces. In one instance, in which probably an ounce of the acid had been swallowed, the individual was able to walk to his home at a distance of three quarters of a mile. In general, the power of locomotion appears to be destroyed in mineral-acid-poisoning, from the extreme severity of the pain. The pulse has been observed to be small, frequent, and irregular: the skin cold and clammy. The intellectual faculties have remained clear until death.

Post-mortem appearances.—The fauces, larynx and œsophagus, have been found highly inflamed, the mucous membrane lying in detached masses or actually sloughing away. In one instance, the membrane was thickened. The coats of the stomach have been so much corroded that, in may places, there was only the peritoneal tunic left; and in attempting to remove the organ in this case, the parietes gave way. The contents have been sometimes of a yellowish, at others of a dark green colour. In one instance, where the fundus of the gall-bladder came in contact with the stomach, it was observed to have a bright green colour, arising from the well-known action of this acid on the bile. In no instance was the stomach perforated. On removing the contents, the lining membrane has been found of a black colour, presenting a charred appearance—the blackening extending through the duodenum its whole length, especially on the prominent parts of the numerous valvulæ conniventes, the intervals being stained of a greenish-yellow colour from the action of the acid on the bile.—(Case by Mr. Quekett, Med. Gaz., Nov. 1839.) When death did not take place until after the lapse of several days, the coats of the stomach were highly inflamed, and for the most part in a state of sloughing;—large dark shreds of membrane were hanging from the sides of the organ, especially about the pylorus. The inflammation had extended also into the duodenum.

Quantity required to destroy life.—With respect to this question and *the period* at which the case proves fatal, there is no reason to suppose that the muriatic acid differs from the sulphuric and nitric acids, in relation to these points. The cases that have hitherto occurred throw but little light upon these questions. The medical jurist must be content to draw an inference, the fairness of which cannot be disputed, when it is based upon the strong analogy which exists between the effects of this and the other two acids. The facts at present before us are these. In one case, two ounces destroyed life in thirty-three hours; in a second, the same quantity killed the person in eight days; and in a third, a like dose proved fatal *in five hours and a half.* This, I believe, is the most rapidly fatal case on record. The smallest dose that appears to have destroyed life was about an ounce. The patient died in fifteen hours. In the case reported by Orfila, the dose was an ounce and a-half, and this proved fatal in about eighteen hours. If cases of poisoning by this substance were more frequent, it would, no doubt, be found that not only might death take place within a much shorter period, but that a much smaller quantity, even one drachm, might prove fatal. All the cases of poisoning by this acid, which I have found reported, have occurred in adults; some from accident, and others from suicide. There is no instance, so far as I know, in which this acid has ever been used for the purposes of murder.

The following case reported by Mr. Crawford, (Lancet, March 1840,) is in several respects interesting to the medical jurist.

A woman aged forty, took, in order to poison herself, two ounces of a mixture used by her husband for the purpose of browning gun-barrels. This mixture was stated to be composed of equal parts of tincture of steel and strong muriatic acid, with a few drops of a solution of corrosive sublimate. Soon after she took the liquid, she vomited. In about half an hour, she was seen by a druggist; but vomiting had then ceased. She answered questions rationally, and was sensible until she died; but made no complaint of heat or pain in the mouth, throat, or epigastrium. There was no thirst. The pulse could not be felt at the extremities, and the heart's action was very feeble. The muscles of the extremities felt hard, as if contracted. She died in about five hours and a half after taking the mixture. Two hours before death, the bowels were opened twice. On inspection, the stomach was found contracted, and its mucous membrane thrown into ridges and furrows. The ridges were of a brown colour, as if charred; when the surface was scraped, it could be readily peeled off, and the part exposed showed numerous small black granules, which seemed to be nothing more than altered blood. The furrows were of a fine scarlet colour. It was not perforated. Appearances similar to these were noticed in the duodenum and jejunum. The lower part of the œsophagus was charred, and its lining membrane was easily peeled off. There is no account given of the state of the mouth, fauces and larynx. There is no doubt, that the active agent and cause of death here, was muriatic acid. An analysis of the mixture proved this, for it yielded an abundance of that acid, and a quantity of iron; but there was no trace of bichloride of mercury.

TREATMENT.—The same as in poisoning by sulphuric and nitric acids.

CHEMICAL ANALYSIS.—The commercial acid has a deep lemon-yellow colour. It contains iron, and often common salt, leaving a residue of impurity on evaporation. It is not commonly so *concentrated*, as to possess the property of fuming in the air; a property which of course depends on its strength, and therefore may be present or absent in any given specimen. The liquid will be found highly acid:—it tinges organic substances of a yellow colour, and corrodes them. 1. When boiled with copper, there is but little action, the acid is distilled over in vapour. 2. The acid, if moderately pure, may be boiled entirely away on mercury without being affected by the metal. These tests eminently distinguish the muriatic from the two preceding acids. 3. When boiled with black oxide of manganese, in fine powder, chlorine is evolved, known by its colour, odour, and bleaching properties on litmus and other colouring matters. This last test is conclusive:—there is no other acid which is thus affected by the peroxide of manganese. One drop of muriatic acid in a tube of very small bore, will give satisfactory results.

TESTS.—When the acid is much *diluted* with water, the property of evolving chlorine with peroxide of manganese, is lost. In this case, there is one most satisfactory test for the presence of muriatic acid—the nitrate of silver. This test gives, with the acid, a dense white clotted precipitate of chloride of silver. The precipitate thus formed, acquires a dark colour by exposure to light, and it is known from all other white salts of silver, by the following properties. 1. It is insoluble in nitric acid. 2. It is very soluble in caustic ammonia. 3. It is insoluble in caustic potash. 4. When dried, and heated on platina or glass, it melts like a resin, forming a yellowish-coloured sectile mass. Unless these properties be possessed by the precipitate, it is impossible to refer the action of the test to the presence of muriatic acid. The delicacy of this test is such, that it will easily detect the one-hundredth part of a grain of muriatic acid diffused in a large quantity of water.

The dilute muriatic acid is also known from the dilute nitric and sulphuric acids, by boiling the liquid with a slip of bright copper and a few drops of a solution of arsenious acid. If muriatic acid be present, the copper acquires a grey coat of metallic arsenic,—with nitric and sulphuric acids it retains its red lustre unchanged. In this way, also, muriatic acid may be discovered when mixed with dilute nitric, sulphuric, or other acids.

Objections.—It may be objected to the application of the silver test, that other acids form with it white precipitates, which might be mistaken for the chloride of silver. There are two common acids, both of them poisons, namely, the prussic and the oxalic, which, in this respect, resemble the muriatic. The prussic acid would be immediately known by its odour. Besides, the white precipitate formed by it (cyanide of silver) is known from the chloride, by being entirely soluble in a large quantity of caustic potash, if some free hydrocyanic acid be present in the liquid. The white precipitate produced by the test in oxalic acid, is known from the chloride by its entire solubility in nitric acid. The evaporation of a portion of the tested acid liquid, would moreover leave crystals of a solid acid. Iodic acid also gives a dense white precipitate with nitrate of silver, and the iodate of silver thus formed, resembles the chloride in being insoluble in nitric acid, and soluble in caustic ammonia. The iodic acid is a body which is rarely met with out of a chemical laboratory. It is immediately known from the muriatic acid, by adding to the liquid, sulphurous acid and starch, when blue iodide of farina is produced. The iodate of silver differs from the chloride, in not being so readily changed by exposure to light: and in being decomposed by caustic potash, which separates from it, brown oxide of silver. The oxalate of silver is also thus known from the chloride: oxide of silver being separated from it, by caustic potash at common temperatures. The chloride is unchanged by caustic potash until heat is applied:—oxide of silver is then slowly produced. Caustic potash may therefore serve to distinguish these analogous salts of silver from each other.

Again, the mixture of any simple acid, such as the acetic, tartaric, or citric, with a solution of common salt, might be pronounced to be muriatic acid from the action of the test, when in reality, no free muriatic acid was present. A suspicion of this kind would naturally arise, when on evaporating a portion of the acid liquid, a large quantity of a solid white residue was obtained. The difficulty in such a case may be removed by resorting to either of the processes recommended in speaking of sulphuric acid (antè, p. 94.) If we take equal portions of the acid liquid, and precipitate one portion entirely by nitrate of silver,—then evaporate the other portion to dryness, dissolve the dry salt in water, and precipitate this solution entirely by the test, it is obvious that if there be no free muriatic acid present, the precipitated chloride will have exactly the same weight in the two cases. The precipitate should in each case be well washed in water, acidulated with nitric acid. If free muriatic acid be present, the precipitate obtained in the former case would exceed in weight that obtained in the latter.

In liquids containing organic matter.—Such liquids will have a highly acid reaction. It might be supposed that the nitrate of silver would serve as a good trial test, but it must be remembered, that this salt is liable to be precipitated by numerous organic liquids, such as vinegar and porter, although no free muriatic acid be present. This arises either from the presence of chlorides in most liquids of this description, or from oxide of silver being itself precipitated by certain organic principles. This test for muriatic acid cannot then be safely employed in the analysis of any liquid containing organic matter. As a trial test we may resort to the experiment with copper and arsenious acid, already referred to. If, on boiling a portion of the organic liquid mixed with arsenious acid, a slip of bright copper immersed in it should acquire a grey metallic coating, this is a proof of muriatic acid being present; but this test will not answer if the acid be in very small quantity. Muriatic acid is not materially affected by organic principles; it forms insoluble compounds with albumen and casein, and also with mucous membrane, whereby a portion may be lost.

There are two ways of proceeding in the analysis of organic liquids. 1. To distil the liquid at a low temperature in a retort fitted with a receiver. Any free muriatic acid passes over, is condensed, and may now be safely tested. As a trial test, we may put a drop of solution of nitrate of silver on a slip of glass, and expose it to the vapour of the liquid submitted to distillation. If muriatic acid be present, a white precipitate will be formed insoluble in nitric acid. This experiment does not absolutely prove the presence of free muriatic acid. Exactly the same results would be obtained if prussic acid were mixed with the organic liquid. The odour would, however, enable the operator to judge which acid was present. Again, a mixture of sulphuric acid with a muriate in the liquid, would produce the same effect and lead to error. The action of nitrate of barytes upon the acid organic liquid, would, however, show whether or not sulphuric acid were present. This process only answers when the muriatic acid is in moderately large proportion. If the quantity be small, none is obtained unless the distillation is carried to dryness, but then the process is open to objection. (See Ann. D'Hyg. Oct. 1842, 318.) 2. We may evaporate to dryness, a fractional portion of the organic liquid; calcine any residue, and observe whether on digestion in water and filtration, we obtain a solution of a chloride; if not, we must neutralize the acid organic liquid by adding carbonate of soda—then evaporate and incinerate the residue. In this way, we obtain all the muriatic acid contained in the liquid as chloride of sodium. Should any chloride result from the first evaporation of the acid liquid,—the quantity of muriatic acid thus obtained, must be deducted from that which results in the last mentioned process.

Vomited matters and contents of the stomach.—The process is the same in the two cases. The liquid should be separated from the solid portions by filtration through cotton or paper. If acid, we must proceed as directed in speaking of the analysis of an organic liquid. In giving evidence on this point, a witness may be fairly asked, whether the natural secretions of the stomach do not owe their acidity to the presence of free muriatic acid. The experiments of Dr. Prout have proved that this is really the case:—that the gastric secretions are acid, owing to the presence of free muriatic and acetic acids. An objection of this kind is answered by the facts,—that the quantity of free muriatic acid, naturally contained in the gastric secretions, does not exceed the 1500th part by weight—five grains in sixteen ounces of liquid.—Prout. This would give only a very feeble acidity, and but a trivial result with the test; whereas, the liquid may be intensely acid, and yield a large quantity of muriatic acid on being distilled. 2. The medical jurist would look for the characteristic symptoms and post-mortem-appearances, before he inferred that the mineral acid had been taken as a poison. If these are wanting, and the quantity of free muriatic acid is but small, then there would be no evidence of poisoning, so far as chemical analysis was concerned.

The liquid for examination may be neutral, owing to the administration of antidotes. The muriatic acid may have been neutralized by carbonate of soda or magnesia. This would be discovered on evaporation, and the quantity of resulting alkaline chloride would indicate the quantity of muriatic acid. But to any inference of this kind, there are very strong objections. If the quantity of chloride of sodium be *small*, the results might be referred to the portion of that salt which always exists naturally in the gastric secretions; if *large*, the chloride of sodium is so common an ingredient in most kinds of food, that its presence in the contents of the stomach might cæteris paribus be fairly ascribed to this source.

On the whole, then, it is clear that the chemical evidence in poisoning by muriatic acid must fail, unless the acid be discovered in large quantity and in a free state, in the contents of the stomach; and unless there be at the same time, corroborative evidence of poisoning from symptoms and post-mortem appearances.

It need hardly be observed, that owing to violent vomiting or medical treatment, all traces of the acid may have disappeared from the stomach, notwithstanding the person may have died from its effects. It does not appear that muriatic acid was found in the stomach in the few cases of poisoning by it, which are on record.

On solid organic substances.—Chemical evidence may be obtained from this source, when other sources fail. In Mr. Quekett's case, no muriatic acid was found in the stomach; but the nature of the poison was accurately determined by analyzing a piece of the deceased's waistcoat, on which some of the acid swallowed, had become accidentally spilled. By digesting the stuff in warm distilled water, a highly acid liquid may be obtained on filtration, which will yield, with nitrate of silver, a white precipitate, possessing all the properties of chloride of siver, supposing muriatic acid to be the cause of the spot. The spots produced on black cloth by strong acid are at first of a bright red, but in ten or twelve days they change to a red brown. Hence it will be perceived that this acid differs from the others in the effect produced on black cloth. Sulphuric and nitric acids produce brown and not red stains. An unstained portion of cloth should always be examined by way of comparison.

It is proper here to mention that muriatic acid, in a diluted state, is sometimes used by forgers to remove ink from paper. A man of the name of Hart was tried at the Central Criminal Court, Dec. 1836, on a charge of forgery under the following circumstances. The prisoner received a blank acceptance for £200, and afterwards erased the figure 2 by an acid, and substituted the figure 5. The witness who gave chemical evidence on this occasion, deposed that some acid had been used to effect the erasure, but he could not ascertain its nature. He suspected that it must have been either the muriatic or oxalic acid, probably the former. Counsel ingeniously objected to the evidence that chloride of lime was used in the manufacture of paper; and might account for the results obtained by the tests; but in answer to this, it was properly stated, that the chloride was entirely removed by subsequent washing.

In a case of this kind, the paper would probably be well washed after the erasure, and this would remove all traces of the acid employed. If any acid liquid were obtained from a stain on paper under these circumstances, the muriatic would easily be known from the oxalic acid by the fact that the chloride of silver is not soluble in nitric acid, while the oxalate of silver is soluble in it.

The Chloride of Sodium has been frequently referred to in this description of the processes for detecting muriatic acid. On this account, as well as from the fact, that it has already caused death when administered in a large dose, (antè, p. 2,) it may be proper to mention the chemical characters by which it may be identified.—1. It is easily dissolved by water, and a portion of the solution slowly evaporated on a slip of glass, yields well-defined *cubic* crystals —2. It is insoluble in alcohol.—3. It yields abundant acid vapours with a kind of effervescence, when strong sulphuric acid is poured on it. These vapours form a dense white solid cloud, when a rod dipped in strong ammonia is brought near them.—4. It yields chlorine gas when heated with equal parts of sulphuric acid, water, and peroxide of manganese :—the chlorine being recognised by its usual characters. About one-twentieth of a grain of the chloride may be in this way analysed, if the experiment be performed in a proportionately small tube.—5. The solution of the salt gives an abundant white clotted precipitate with nitrate of silver—possessing all the chemical properties of chloride of silver. These properties of the precipitate must be positively determined, since there are numerous other salts which are precipitated white by nitrate of silver. These experiments, it will be perceived, merely indicate the presence of chlorine or muriatic acid. The characters of soda will be given hereafter. A chloride is also known by boiling it in a solution of arsenious acid and sulphuric acid, and immersing a slip of bright copper—if the salt be a chloride, the copper is covered with a grey coat of arsenic.

Quantitative analysis.—This may be performed by estimating the quantity of muriatic acid from the quantity of chloride of silver obtained from the whole, or a fractional part of the liquid subjected to analysis For every 100 grains of the thoroughly dried chloride of silver, we may allow sixty-nine grains of liquid muriatic acid of the ordinary pharmacopœial strength.

CHAPTER XIV.

POISONING BY MIXED ACIDS. COMPOUND POISONING. MEDICO-LEGAL QUESTIONS RELATIVE TO POISONING BY THE MINERAL ACIDS.

In general the mineral acids are taken separately as poisons; but it may happen that they will be taken in a mixed state; more especially as some mixtures of this description are largely used in the arts. Thus, the AQUA REGIA, a mixture of nitric and muriatic acids, is used for dissolving gold and platina; while the AQUA REGINÆ nitro-sulphuric acid, is employed for dissolving silver and separating it from plated articles. I have not been able to find in any work on toxicology, an account of a case of poisoning by the nitro-muriatic acid; but Orfila gives one case of poisoning by nitro-sulphuric acid.

A man aged twenty-four, swallowed a mixture consisting of one ounce of strong nitric acid and two drachms of strong sulphuric acid. The usual symptoms followed, and he died in eight hours. The post-mortem appearances, as might have been presumed from the relative quantities of the two acids taken, were more those of nitric than of sulphuric acid. (Toxicologie Générale i. 109.)

There is but little doubt that nitro-muriatic acid would produce symptoms, and cause appearances, analogous to those described in speaking of muriatic acid. The mixed effects of nitric acid might be also perceptible. The quantity required to destroy life, and the period at which death will ensue, may be inferred from what has been already said of those acids.

CHEMICAL ANALYSIS. *Nitro-muriatic acid.*—This liquid is of a deep yellow or red colour, and is intensely acid.—1. It is known from its two component acids, by immediately dissolving leaf-gold, either with or without the aid of a gentle heat.—2. On boiling a portion of the mixture, chlorine gas is evolved; and litmus paper is bleached at the mouth of the vessel.—3. Muriatic acid is discovered, by adding to it, when diluted, nitrate of silver.—4. Nitric acid is detected by boiling in it some cuttings of copper—the red fumes of nitrous acid are evolved. Unless there be sulphuric acid present, nitrate of barytes will give no precipitate with the diluted acid. It is difficult to understand, that it would ever be necessary for legal purposes to determine the relative proportions of nitric and muriatic acids in this compound. If such a necessity arose, oxide of silver might be used to separate the muriatic acid, and the quantity of this deducted from the whole quantity of acid experimented on, would give the proportion of nitric acid. There are other methods of a purely chemical nature for which chemical works may be consulted.

Nitro-sulphuric acid.—This acid may be easily mistaken for sulphuric acid, since it gives a white precipitate with a salt of barytes, and the nitric acid remains concealed.

Process.—Add carbonate of barytes in fine powder to the mixed acids, largely diluted, until they are neutralized. The sulphuric acid alone is precipitated, as sulphate of barytes. This may be separated by filtration, washed with water acidulated with nitric acid, dried and weighed, by which the quantity of sulphuric acid will be determined. The filtered liquid, on being evaporated, will yield crystals of nitrate of barytes, in which the presence of nitric acid may be easily determined by the usual tests. In the arts, it is common to employ a mixture of sulphuric acid and nitrate of potash, instead of nitric acid. In this case, the carbonate of barytes would precipitate the sulphuric acid, and leave the nitrate unaffected, so that the analysis is rendered more easy. Both the nitro-muriatic and nitro-sulphuric acids discharge the colour of sulphate of indigo at a boiling temperature.

In concluding this account of the mineral acids, it will be proper to consider the medico-legal questions that are likely to arise respecting this form of poisoning, in addition to those which have already been examined. There are some questions common to all the acids; and these were succinctly and clearly stated in respect to nitric acid by Tartra, in his Traité de l'Empoisonnement, published in 1802.

1. *Can poisoning by the mineral acids be feigned?*

It might seem superfluous to raise such a question, yet the author to whom I have above referred, relates an instance where a young lady pretended that she had swallowed aqua fortis, but the imposition was easily detected. Vomiting and pain in the abdomen may easily be feigned; but the fact is, there are too many well-marked peculiarities in poisoning by either of the three acids, more especially in relation to their local effects on the mouth and fauces, to render such an imposture successful.

2. *Can a medical jurist pronounce judicially from symptoms only, that a person has been poisoned by one or other of the mineral acids?*

If we find that the particular symptoms described, of intense burning pain in the throat and fauces, have immediately followed the swallowing of some sour liquid;—if the matters vomited be highly acid,—dark coloured and mixed with shreds of mucus and altered blood, there can be but little doubt, that the symptoms must have been caused by a mineral acid. At any rate, there is no disease, commencing suddenly in a healthy person, which would be likely to produce them. A doubt may arise, whether they may not have been caused by some other poison. An examination of the mouth and fauces will, however, assist the judgment. If a mineral acid were the cause, the membrane will be found corroded, discoloured and dissolved;—in poisoning by sulphuric acid, of a black or brown colour, and by nitric acid, of a yellow or citron colour. With respect to this criterion, however, it must be remembered that the mucous membrane of the mouth has been found white in poisoning by these two acids. Then, again, spots indicative of the nature of the acid may be found spilled on the skin or clothes. Whenever the cause of the symptoms is at all doubtful, no opinion should be expressed in favour of poisoning, unless the mineral acid be actually discovered in the matters vomited from the stomach.

3. *Can a medical jurist pronounce from post-mortem appearances only, whether the deceased has been poisoned by one or other of the mineral acids?*—Zacchias, Plenck, Morgagni, and many medico-legal

writers, have laid it down as an axiom in legal medicine, that the only certain evidence of poisoning is the discovery of the poison itself in the stomach or intestines. Even Orfila adopts as a motto to his great work on Toxicology, the dictum of Plenck; "Unicum signum *certum* dati veneni est *notitia botanica* inventi veneni vegetabilis, et *criterium chemicum*, dati veneni mineralis." It is fortunate that the law does not act upon this doctrine; for as there are very good medical reasons, why a poison, when actually the cause of death, should not always be found in the stomach, it is clear, if this were a rule of law, that a conviction for poisoning would always rest upon pure accident. Perhaps there is no form of acute poisoning, in which a medical jurist has it more in his power to pronounce an opinion from post-mortem appearances, than in these cases of death from the mineral acids. Tartra long since observed, that, whenever the alimentary canal from the mouth to the intestines, was found corroded and converted to a soft fatty substance of a bright yellow or brown colour, when it was easily detached from the subjacent parts, and there were marks of inflammation or gangrene or actual perforation of the stomach, there could be no doubt that these effects were due to a mineral acid, whether the acid were discovered in the body or not. Dr. Christison has also adopted this view; and he very properly remarks, that such cases must be considered as distinct exceptions to the general rule, regarding the weakness of evidence derived from post-mortem appearances. Indeed, it may be inquired of those who are disposed to entertain an adverse opinion, what conceivable form of disease can produce such well-marked appearances simultaneously in the mouth, fauces, œsophagus, stomach and intestines, in the course of a few hours? In the case of Humphreys, given in a former chapter, the prisoner was properly convicted of murder by poisoning with sulphuric acid, although no trace whatever of that poison could be discovered in the body.

On these occasions, it would not be safe to trust to appearances in the stomach alone. I have seen the mucous membrane of this organ very much blackened, although not corroded, in a case where death had taken place from natural causes, i. e. perforation of the stomach. The appearance was precisely like that which was met with in a case of poisoning by sulphuric acid. (Guy's Hospital Reports, No. 8). It is therefore necessary in every suspected case, that attention should be paid to the condition of the mouth, fauces, and œsophagus. The spontaneous and morbid changes to which the stomach is liable, do not affect these parts. If the latter be healthy and unaffected, we cannot safely infer, in a doubtful instance, whatever may be the condition of the stomach, that a strong mineral acid has been taken.

In cases of chronic poisoning, the appearances in the body may be obscure and present nothing characteristic.

4. *A mineral acid may be introduced into the dead body. Is it possible to determine whether the corrosive poison has been taken during life or designedly introduced after death?* This question is purely

speculative; for it is difficult to understand, how a strong mineral acid should be introduced into the stomach of a dead subject, even supposing that any object for such an act should exist. The only motive would be the imputing of a charge of poisoning to another, which might be disproved by the history of the case, without reference to the discovery of poison in the dead body. In order to distinguish such a case, the following points may be attended to. Those who die from this kind of poisoning, generally live sufficiently long to allow of the establishment of well-marked vital reaction in the organs affected. There may be not merely a chemical corrosion of parts, but marks of inflammation, gangrene and the effusion of lymph. If the poison were swallowed during life, these effects would be apparent from the mouth and fauces downwards. The sulphuric and nitric acids will stain and corrode the parts of a dead body with which they are in immediate contact; but they will not produce any appearance of vital reaction in the surrounding structures. I have not found that strong sulphuric acid readily charred the dead stomach or duodenuum until its effect was aided by heat, nor did it ever produce a red or inflamed appearance.

5. *A person has taken a mineral acid and died. Is it possible to determine whether death was produced by the acid or by some other latent cause?*—This question has been already fully discussed in relation to general poisoning; but it is much more simple and more easily answered, when it is restricted to poisoning by the mineral acids. The symptoms preceding death from these poisons, and the well-marked chemical effects produced by them from the mouth downwards, will readily enable a medical jurist to form an opinion of the real cause of death. The symptoms produced by perforation of the stomach from disease, somewhat resemble this kind of poisoning; but the course of this disease is to destroy life by inducing peritonitis. It would be, indeed, a singular coincidence, that perforation in the stomach, and poisoning by a mineral acid, should occur simultaneously in a person: and in such a case, a decision might be difficult. The inference would probably be that the perforation was caused by the poison. (See antè, p. 74). Orfila mentions a case, where a patient in a public hospital, had an ounce and a half of muriatic acid given to him by mistake, and he died under the usual symptoms within twenty-four hours. On inspection, the lips were found black, the tongue brown, thickened, hard and dry:—the pharynx and œsophagus were of a deep purple red colour, and excoriated in several places. The stomach was inflamed and gangrenous—its mucous membrane separating in layers;—the duodenum was in the same state. The jejunum was perforated by a lumbricus which was found in the cavity of the abdomen. (Toxicologie, i. 134.) There was no doubt in this case, from the symptoms and post-mortem appearances, that death was immediately due to the action of the mineral acid. Where the disease is merely of a chronic nature, there would be no difficulty in forming a diagnosis.

CHAPTER XV.

POISONING BY OXALIC ACID. BINOXALATE OF POTASH. (SALT OF SORREL.)

Oxalic acid is one of the most powerful of the common poisons, although its use as such is almost entirely confined to this country. Cases of poisoning by it, are generally the result of suicide or accident. In the coroner's return for 1837-8, there were nineteen cases of poisoning by this substance, out of which number, fourteen were the result of suicide. It is singular also, that the greater number of these, occurred in the county of Middlesex. Accidental poisoning by oxalic acid has arisen from its strong resemblance to Epsom salts. It is rare to hear of its being used as a poison for the purposes of murder. Its intensely acid taste, which could not be concealed by admixture with any common article of food, would infallibly lead to detection, long before a fatal dose had been swallowed. I have known two trials to take place for attempted poisoning by oxalic acid, and in these the vehicle, selected for its administration, was coffee or tea.

Symptoms.—In many cases of poisoning by this substance, death has taken place so rapidly, that the individual has not been seen alive by the medical practitioner. If the poison is taken in a large dose, i. e., from half an ounce to an ounce of the crystals dissolved in water, a hot burning taste is experienced in the act of swallowing, and vomiting occurs either immediately, or within a few minutes. Should the poison be diluted, there is merely a sensation of strong acidity, and vomiting only occurs after a quarter of an hour or twenty minutes. In some instances, there has been very little or no vomiting; while in others, this symptom has been incessant until death. The vomited matters are highly acid, and have a greenish brown, or almost black colour; they consist chiefly of mucus and altered blood. There is at the same time great pain and tenderness in the epigastrium, followed by cold clammy perspiration and convulsions. In a case which occurred at Guy's Hospital, in May 1842, where about two ounces of the poison had been swallowed, there was no pain. Urgent vomiting and collapse were the chief symptoms. There is entire prostration of strength, so that the individual falls, if he be in the erect position; there is likewise unconsciousness of surrounding objects, and a kind of stupor, from which, however, the patient may be without difficulty, roused. From the severity of the pain, the legs are sometimes drawn up towards the abdomen. The pulse is small, irregular and scarcely perceptible; there is a sensation of numbness in the extremities, and respiration, shortly before death, becomes spasmodic. The inspirations are deep, and a long interval elapses between them. Such are the symptoms commonly observed in a rapidly fatal case.

Should the person survive the first effects of the poison, the following symptoms appear: There is soreness of the mouth,—constriction in the throat, with painful deglutition,—tenderness in the abdomen, with irritability of the stomach, so that there is frequent vomiting, accompanied by diarrhea. The tongue becomes swollen, and there is great thirst. The patient may slowly recover from these symptoms. In a case related by Mr. Edwards to the Westminster Medical Society, the patient, a female, lost her voice for eight days; but whether this depended on the action of the oxalic acid which she had taken, or not, it is difficult to say. Certain it is, that this poison has a remote effect on the nervous system, indicated by the numbness and tingling in the extremities, which have been observed to remain, long after the person has recovered from the first effects.

POST-MORTEM APPEARANCES.—The lining membrane of the mouth, fauces and œsophagus, is commonly white, although it is often coated with a portion of the dark brown mucous matter discharged from the stomach. This latter organ contains a dark brown mucous liquid, often acid, and having almost a gelatinous consistency. On removing the contents, the mucous membrane will be seen pale and softened, without presenting any marks of inflammation or abrasion, if death has taken place rapidly. This membrane is soft and brittle, easily raised by the scalpel, and presents much the appearance, which we might suppose it to assume, after having been for some time boiled in water. The small vessels are seen ramifying over the surface, filled with dark coloured blood, apparently solidified within them. The lining membrane of the œsophagus presents much the same characters. It is pale, and appears as if it had been boiled in water, or digested in alcohol; it has been found strongly raised in longitudinal rugæ, interrupted by patches where the membrane has become abraded. With respect to the intestines, the upper portion of the canal may be found inflamed; but unless the case is protracted, the appearances in these viscera, are not very strongly marked. In a recent case of poisoning by this acid, where two ounces had been taken, and death was rapid, the coats of the stomach presented almost the carbonized appearance produced by sulphuric acid.

Oxalic acid does not appear to have a corrosive action on the stomach like the mineral acids. It is rare to hear of the coats of the organ being perforated by it. In many experiments on animals, and in some few observations on the human subject, I have fonnd nothing to bear out the view that perforation is a common effect of the action of this poison. It renders the mucous coat soft and brittle. Dr. Christison refers to only one instance, in which the stomach was found perforated.

In protracted cases, the œsophagus, stomach, and intestines have been found more or less inflamed. In some instances, there have been scarcely any perceptible morbid appearances produced.

QUANTITY REQUIRED TO DESTROY LIFE.—A trial for murder by this poison took place in 1832, in which this question was put judicially the medical witnesses. One deposed, that he thought ten grains of the acid was sufficient to destroy life, another that it was not sufficient. The prisoner was acquitted. A question of this kind can only be solved by a reference to recorded facts; but unfortunately, in most cases, it has been impossible to determine exactly the quantity of poison taken.

Oxalic acid, it is to be observed, presents some singular anomalies in its effects. In one case, a man swallowed, as nearly as could be ascertained, three drachms of the crystals:—there was immediate vomiting, but no other urgent symptoms, and he recovered in a few hours. In a second instance, a woman took nearly half an ounce of oxalic acid—the usual symptoms appeared—she recovered in six days, and was able to leave the hospital. Mr. Semple met with a case, where a girl swallowed about *two drachms* of the poison dissolved in water. Vomiting occurred immediately. In about twelve hours, the more urgent symptoms had disappeared; but there was still tenderness of the epigastrium with irritability of the stomach. In the course of a few days, the patient was quite well. In February, 1842, a case occurred at King's College Hospital, where a girl had swallowed *two drachms* of the acid, dissolved in beer. The only symptom from which she suffered on admission, was pain. She entirely recovered the next day. Dr. Babington, of Coleraine, reports a case (Med. Gaz. xxvii. 870,) in which a girl swallowed by mistake two scruples *(forty grains)* of the poison. Severe symptoms followed, chiefly marked by great gastric irritation. It was a week before this girl was convalescent, and a much longer time elapsed, before she was able to resume her duties. In all of these cases, it is to be observed, active medical treatment was resorted to; and the effects of the poison may be therefore supposed to have been in a great degree counteracted. This will also explain, why some have recovered, who have taken even half an ounce or more of the poison, while others have died where the dose has not exceeded that quantity. A smaller dose than half an ounce of the crystals, has not, so far as I am aware, been known to prove fatal; although from the serious effects which have followed doses less than this, it is probable that a smaller quantity might destroy life where medical treatment was not resorted to. Two cases have occurred at Guy's Hospital, where in each, half an ounce of oxalic acid had been swallowed. Active treatment was adopted, and both patients recovered. When the dose is upwards of half an ounce, death is commonly the result. But one of my pupils lately informed me of a case where a man recovered, after having taken one ounce of the crystallized oxalic acid.

Period at which death takes place.—It is proper to observe, that the same quantity of the poison does not always destroy life within the same period of time. In two cases, where about two ounces of the acid were taken, one man died in twenty minutes,—the other in three quarters of an hour. Dr. Christison mentions a case, where an ounce killed a girl in thirty minutes; and another where the same quantity destroyed life in ten minutes. This last is perhaps the most rapidly fatal case on record. When the dose is half an ounce and upwards, death commonly takes place in an hour. There are, it must be admitted, numerous exceptions to this rapidity of action. Dr. Christison reports two cases, which did not prove fatal for thirteen hours; and in an instance, that occurred to Mr. Fraser, in which only half an ounce was taken, the individual died from the secondary effects in a state of perfect exhaustion, twenty-three days after taking the poison.

TREATMENT.—It is recommended that water should be sparingly given, as it is apt to lead to the more extensive diffusion and absorption of the poison. But in some instances water has been found to be productive of great benefit; and has aided the efforts of the stomach to expel the poison by vomiting. The proper antidotes are chalk or magnesia or its carbonate, made into a cream with water, and freely exhibited. These remedies appear, from the cases reported, to have been very efficacious when timely administered. A mixture of lime water and oil might be advantageously employed. If much fluid has been swallowed, then the stomach pump may be resorted to. The poison in many instances acts with such rapidity, as to render the application of these remedies, a hopeless measure. The exhibition of the alkalies,—potash, soda or their carbonates, must in all cases be avoided; since the salts which they form with oxalic acid, are as poisonous as the acid itself.

CHEMICAL ANALYSIS. *In the simple state.*—This acid may be met with, either as a solid, or in solution in water. *Solid oxalic acid.* It is seen more or less perfectly crystallized in four-sided prisms, in which respect it differs from all other acids, mineral and vegetable. The crystals are unchangeable in air. They are soluble both in water and alcohol. The solubility in water is variously stated. I have found some specimens much more soluble than others; and the conclusion from the experiments which I have made is, that the acid is soluble in from twelve to fourteen times its weight of water. If there be any adhering nitric acid about tbe crystals, they are much more soluble.

The crystals of oxalic acid are liable to be mistaken for those of two other salts, namely, the sulphate of magnesia (Epsom salts), and sulphate of zinc (white vitriol). The chemical differences are, however, well marked. Oxalic acid, when heated on platina foil, is entirely volatilized, while the sulphates of magnesia and zinc are fixed. If the three substances be dissolved in water, it will be found that, while the solution of oxalic acid is intensely acid,—that of the sulphate of magnesia is neutral,—and of the sulphate of zinc, very feebly acid. If a solution of caustic potash be added to the diluted solutions of the three bodies in water,—those of magnesia and zinc yield white flocculent precipitates, that of oxalic acid remains unchanged. The most simple method of distinguishing them is by the taste. Oxalic acid is immediately indicated by the intense acidity of its solution.

For the further analysis of the acid, the crystals must be dissolved in distilled water: but should a suspected *solution* of the poison in water, be presented for examination, it will be proper, after testing it with litmus paper, to evaporate a small quantity on a slip of glass, in order to observe whether crystals be obtained. If there should be none, there can be no oxalic acid present. If fine and distinct prisms be procured, then it will be proper to proceed with the analysis of the solution.

TESTS.—1. Nitrate of silver. When added to a solution of oxalic acid, it produces an abundant white precipitate of oxalate of silver. A solution containing only the 4000th part by weight of oxalic acid, is affected by this test; but where the quantity of poison is small, it would be always advisable to concentrate the liquid before applying it. The oxalate of silver is identified by the following properties: 1. It is completely dissolved by nitric acid, by which it is known from the chloride, iodate and cyanide. 2. When collected on a filter, dried and heated on platina foil, it is entirely dissipated in a white vapour with a slight detonation. 2. A solution of oxalic acid is precipitated white, by lime water and all the salts of lime. Lime water is itself objectionable as a test, because it is precipitated white by many other acids, as the carbonic, tartaric, phosphoric and arsenious. The salt of lime, which, as a test, is open to the least objection, is the sulphate. As this is not a very soluble salt, its solution must be added in rather large quantity, to the suspected poisonous liquid. A fine white precipitate of oxalate of lime is slowly formed. This precipitate should possess the following properties: 1. It ought to be immediately soluble in nitric acid. 2. It ought not to be dissolved by the tartaric or any vegetable acid. Unless these precipitates be obtained, and their properties, as above described, determined, it cannot be said that oxalic acid is present in the solution.

Objections to the tests.—A liquid may be highly acid, yield crystals of oxalic acid on evaporation, and yet neither of the above-mentioned tests will act. This may happen when nitric acid is present in rather large proportion. As a matter of precaution in a doubtful case the whole of the solution should be evaporated to crystallization, and the crystals dried and re-dissolved in water, before performing the experiments.

It may be urged that the nitrate of silver precipitates other acids. Thus it forms white precipitates with the muriatic, prussic and iodic acids, but these precipitates are insoluble in nitric acid and do not detonate when dried and heated. The test gives only a slight turbidness with the tartaric and citric acids when highly concentrated, instead of the abundant milk-white precipitate which is produced in a solution of oxalic acid, even when considerably diluted. Besides, there is no acid but the oxalic, which is precipitated by sulphate of lime. There could be no objection to this last-mentioned test, except that it precipitates acid as well as neutral solutions of the salts of barytes and strontia; and an acid solution of muriate of strontia might somewhat resemble in this respect a solution of oxalic acid; but not to mention that there are numerous ways by which this kind of difficulty may be easily removed,—the sulphates of barytes and strontia are eminently distinguished from oxalate of lime, by their perfect insolubility in nitric acid.

It has been recommended to neutralize the oxalic acid by ammonia, or potash, before applying the tests. The tests then certainly precipitate the oxalic acid more rapidly and abundantly. The objections, however, to the results become more numerous; and although these are easily susceptible of being removed in the hands of a practised toxicologist, it must be confessed that just doubts might often be entertained of the accuracy of the inference drawn from them by others. If the poison be already neutralized, as under the form of oxalate of ammonia, we have no alternative but to apply them. But we must remember that, while the two tests above mentioned, nitrate of silver and sulphate of lime, are precipitated by very few acids, they are precipitated by numerous salts; and the precipitates possess properties, which it is sometimes difficult to distinguish from those of the oxalates of lime and silver. Thus the alkaline tartrates, citrates, carbonates, phosphates, and iodates, are precipitated by one or both of the tests, like the oxalates; and if muriate of lime be used instead of the sulphate of lime, the alkaline sulphates would also be precipitated. It may be observed, however, that the recently precipitated tartrate and citrate of silver are distinguished from the oxalate, 1, by their being decomposed on boiling while the oxalate of silver retains its whiteness, and is not decomposed at a boiling heat. 2. The dried tartrate, heated on platina, burns without detonation: it becomes incandescent, and leaves a solid residue of metallic silver in a white fungous mass. The dried citrate partially decrepitates, and leaves a grey fibrous residue of metallic silver. Thus, then, these salts differ from the oxalate, which is entirely dissipated by detonation. Again, sulphate of lime does not precipitate an alkaline tartrate or a citrate, unless the salts be highly concentrated, while an oxalate is precipitated by the test even in the most diluted state. If, therefore, any doubt exist respecting the nature of the salt, it should be diluted with water before adding the test. The dried precipitates also differ. The oxalate of lime is silently converted, when heated on platina, to carbonate of lime or caustic lime, according to the temperature. The tartrate and citrate undergo partial combustion, leaving a grey or carbonaceous residue.

Other tests have been proposed, as, for instance, the sulphate of copper, and solution of strontia, but they add no force to the evidence afforded by those above-mentioned, and we may conclude that when we obtain from an acid solution a solid acid substance crystallizing in well-defined prisms,—these crystals remaining unchanged in air, being volatilizable without combustion, and giving, when dissolved in water, on addition of the nitrate of silver and sulphate of lime, the results above described, there can be no doubt that the substance is oxalic acid. Additional tests may or may not be employed, but any evidence, short of this, should not, it appears to me, be admitted, to show the presence of the poison.

In liquids containing organic matter.—The process is the same, whether it apply to liquids in which the poison is administered, or to the *matters vomited*, or lastly, to the *contents of the stomach.* This poison is not liable to be decomposed or precipitated by organic principles; and, therefore, it is commonly found in solution in the liquid portion, which will then have a greater or less acid reaction. Should the liquid be very acid, we must filter it to separate any insoluble matters; should it not be very acid, the whole may be boiled, if necessary, with distilled water, before filtration is performed. A small quantity of the liquid may now be tested by solution of sulphate of copper. This serves as a trial test; for oxalic acid is the only acid precipitated by it. If a greenish white precipitate is formed either immediately or in a few minutes, oxalic acid may be present; but if none is formed, then either there is no oxalic acid present, or it is in very small quantity. On no account are the tests for oxalic acid to be employed in liquids containing organic matter, since both nitrate of silver and sulphate of lime are easily precipitated by such matters, although none of the poison be present. It must be remembered that the sulphate of copper will not precipitate oxalic acid if it be mixed with a strong mineral acid.

If the liquid be highly coloured, it may first be boiled for some time with well-washed animal charcoal. After this it may be filtered and concentrated by evaporation. To the filtered liquid, acetate of lead should be added until there is no further precipitation; and the white precipitate formed, collected, and washed. If any oxalic acid were present in the liquid, it will exist in this precipitate under the form of oxalate of lead. There are two methods of separating oxalic acid from the oxalate of lead.

1. Diffuse the precipitate in water, and pass into the liquid for about two hours, a current of sulphuretted hydrogen gas, (for preparation see pôst, Tests,) taking care that the gas comes in contact with every portion of the precipitate. Black sulphuret of lead will be precipitated; and with it commonly the greater part of the organic matter, which may have been mixed with the oxalate of lead. Filter to separate the sulphuret of lead; the filtered liquid may be clear and highly acid. Concentrate by evaporation; the sulphuretted hydrogen dissolved in the liquid is thereby expelled, and oxalic acid may be ultimately obtained crystallized by evaporation on a piece of plate glass If there were no oxalic acid present in the precipitate, no crystals will be obtained on evaporation. If crystals are obtained, then they must be dissolved in water and tested in the way above directed.

2. The second process consists in boiling the precipitated oxalate of lead

in water, containing a small quantity of sulphuric acid (the proportion regulated by the quantity of precipitate) for half an hour. Sulphate of lead is formed and oxalic acid is set free; this becomes mixed with any surplus sulphuric acid. Filter and neutralize cautiously by ammonia; the liquid then often becomes turbid from the precipitation of a small quantity of oxalate of lead suspended by sulphuric acid Allow this to subside, and then test it with the nitrate of silver and sulphate of lime. The characters of oxalic acid, if it be present, are immediately brought out; the sulphate of ammonia, here formed with the oxalate, does not in the least interfere with the application of these tests.

I have used both of these processes in two cases of poisoning, and have succeeded in detecting a small quantity of oxalic acid by them, in the contents of the stomach. In both cases there had been violent vomiting,—one proved fatal in twenty minutes, the other in three quarters of an hour. Of the two processes, the first is the best adapted for obtaining crystallized oxalic acid; the second is the more expeditious for obtaining evidence of the presence of the poison.

Objections.—If, in the course of this analysis, acetate of lead should give no precipitate with the liquid even when neutralized,—then oxalic acid is not present in a quantity sufficient to be detected. If it should give a precipitate, still there may be no oxalic acid present. The medical jurist must remember, that the acetate of lead is precipitated by most kinds of organic matter, and by many mineral and vegetable acids and their salts. Thus, if he be operating on the contents of the stomach, the presence of Epsom salt, (sulphate of magnesia), any alkaline sulphate, common salt, (chloride of sodium,)—any tartrate, citrate, phosphate, or carbonate, would occasion a white precipitate with the acetate of lead. The presence of the sulphuric, muriatic, tartaric, or citric acid, either free or mixed with any of the above-mentioned salts, would produce the same result. The answer to any objection of this kind, is, that the analyst does not decide on the presence of oxalic acid from the effect of acetate of lead on the suspected liquid; but from the action of the proper tests for the poison on the acid substance separated from the precipitate, formed by the acetate of lead. This latter is not a test, but merely a means of separation to enable us to apply the other tests with safety.

It is difficult to state the exact length of the period after death, at which we might expect to discover this poison in the contents of the stomach. Having on one occasion detected it in the contents of the stomach of a person who had been poisoned, I placed the liquid aside for about *five* weeks during the summer. On re-examining it at the end of this period, it had become highly putrefied, ammonia had formed, and not a trace of the poison could be detected. Nevertheless, except when in very small quantity, and under exposure to extreme putrefaction, oxalic acid does not seem to be liable to disappear in contact with animal and vegetable substances. On the 19th January, 1835, *forty grains* of oxalic acid were added to six ounces of a mixture composed of gruel, porter and albumen. The liquid has been kept in a bottle loosely corked: and although upwards of *eight years* have elapsed, the liquid is still acid; and oxalic acid may be readily detected in it.

The stomach after death may contain no traces of the poison. This will happen where the case is protracted,—vomiting has been urgent or the stomach-pump employed. On the other hand, the poison may be present, but in an insoluble form, where lime or magnesia has been given as an antidote. White chalky masses may in this case be found adhering to the mucous surface of the stomach, or subsiding as a sediment in the liquid contents. The analysis for oxalate of lime will answer for the oxalate of magnesia.

Oxalate of Lime.—As a trial test, dissolve some of the well-washed chalky sediment in dilute nitric acid:—then add nitrate of silver;—there may or may not be a precipitate according to the quantity of nitric acid used. We must then neutralize the liquid by weak ammonia, and a white precipitate will fall, which, if oxalate of lime were present, will be oxalate of silver. This may be dried, and then tested in the way described.

A direct chemical analysis may be made by boiling the suspected oxalate of lime for about twenty minutes, with an equal weight of carbonate of potash, in distilled water. A partial double decomposition takes place :—the undissolved residue containing some carbonate of lime, and the liquid some oxalate of potash. The liquid may be filtered, neutralized by nitric acid, and then tested with the tests already described for a soluble oxalate. If there be any desire to determine the nature of the alkali with which the oxalic acid is combined, some of the sediment may be calcined on platina foil, when caustic lime or magnesia will be left, easily known from each other by their respective chemical characters.

The discovery of oxalate of lime in the stomach, is said to be no proof of oxalic acid having been taken as a poison, because rhubarb powder contains that salt. Admitting this latter statement to be correct, of which I have some doubt, having examined two different specimens of rhubarb powder without discovering any trace of oxalic acid, either combined with lime or any other base ; it is difficult to comprehend how this can form any objection to the inference from a medico-legal analysis of the contents of the stomach. Oxalate of lime is never found in the stomach in a case of poisoning by oxalic acid, unless an antidote of lime has been given. But if an antidote has been used, there will be evidence from symptoms, and in this case the discovery of any portion of oxalic acid in the stomach after death, may perhaps not be at all material :—the fact of poisoning would be sufficiently apparent from other circumstances. To give this objection any sort of force, it is necessary to suppose that a person, after having swallowed a dose of rhubarb, is by a mere coincidence seized with symptoms resembling those of poisoning by oxalic acid, and dies :—chalk mixture having been exhibited before death :—further, that on inspection, no appearances indicative of the action of oxalic acid, are found in the fauces, œsophagus, or stomach ; and lastly, that the presence of oxalate of lime in the stomach, is of itself chemical evidence that the person has died from taking oxalic acid ! Such a case appears to me to carry with it its own refutation, in the facts which must necessarily accompany it.

Oxalic acid has been supposed to enter the blood, and give it a dark brown colour. In a case which proved rapidly fatal, where two ounces of the poison had been taken, I examined four ounces of blood taken from the vena cava : but not a trace of oxalic acid could be detected. Dr. Christison states that he did not succeed in detecting the poison in the blood when it had been purposely injected into the femoral vein of an animal which died in thirty seconds. These negative results may be explained by supposing that the poison is decomposed, or the means of separating it from organic compounds are not sufficiently delicate. In two cases, leeches have been killed by the blood drawn by them, from persons who were at the time labouring under the effects of this poison. This seems to render it probable that the blood is poisoned. When solid organic matters, such as cloth, paper, or linen, are impregnated with oxalic acid, proofs of this may be obtained, by digesting the spots in water and applying the usual tests. Oxalic acid does not corrode these substances like a mineral acid, but it slowly produces orange yellow spots on black cloth. This acid is sometimes used for erasing writing-ink in cases of forgery.

QUANTITATIVE ANALYSIS.—The quantity of oxalic acid present in a measured portion of any mixture, may be best estimated by precipitating it entirely as oxalate of lead. For every hundred grains of the dried precipitate we may allow forty-two grains of crystallized oxalic acid. In some instances, it may be more convenient to precipitate it as oxalate of lime by means of muriate of lime; the quantity of oxalic acid may then be estimated from the equivalent of that oxalate.

BINOXALATE OF POTASH.—SALT OF SORREL.—It will be necessary to speak of this salt, in this place, since its poisonous properties entirely depend on the oxalic acid which it contains. It is said to be much used for the purpose of bleaching straw and removing ink-stains, —being sold under the name of essential salt of lemons. Its poisonous properties are not commonly known, or no doubt it would be frequently substituted for oxalic acid. Three cases of poisoning by this substance have occurred within the last few years, two of which proved fatal, while in the other, the patient recovered.

In the case of recovery a young lady, aged twenty. swallowed an ounce of the salt dissolved in warm water. She was not seen by any one for an hour and a half: she was then found on the floor, faint and exhausted, having previously vomited considerably. There was great depression, the skin cold and clammy, the pulse feeble, and there was a scalding sensation in the throat and stomach. There were also continued rigors. Proper medical treatment was adopted, and she recovered in two days,—still suffering from debility and great irritation of the stomach. During the state of depression, it was remarked that the conjunctivæ were much injected, and the pupils dilated. There was also great dimness of vision. (Med. Gaz. xxvii. 480.)

In another of the cases,—a lady recently confined took by mistake half an ounce of the binoxalate instead of cream of tartar. She had scarcely swallowed the draught, when she was seized with violent pain in the abdomen and convulsions: she died in *eight minutes.* On inspection, the mucous membrane of the stomach and small intestines was found inflamed. (Ann. D'Hyg. Avril, 1842.) In the third case, a teaspoonful of this salt was taken for three successive mornings:—it produced severe vomiting; and about an hour after the third dose, the patient expired. There was no post-mortem examination.

We learn from these cases, that this salt is poisonous, destroying life almost as readily as oxalic acid itself; and that in the symptoms which it produces, it closely resembles that poison. In the second case, it destroyed life even more rapidly than oxalic acid has ever been known to do, i. e. in *eight minutes;* but probably the fatal effects were there accelerated by the debilitated state of the person who took it.

CHEMICAL ANALYSIS.—The *solid* salt is commonly seen in the form of a crystalline powder, or loosely crystallized in masses. It is not very soluble in water, easily taken up on boiling, but re-precipitated in great part, on cooling. Its solution might be easily mistaken for oxalic acid; for, 1, it has an acid reaction; and, 2nd, it is precipitated by nitrate of silver and sulphate of lime, like oxalic acid; but with respect to the latter test, the precipitation, although more slowly formed, is much more copious. It is best known from oxalic acid, 1, by its crystalline form, which is plumose, and, 2, by heating a portion on platina foil. While oxalic acid is volatile, the binoxalate leaves an ash, which, when sufficiently calcined, is alkaline, and it may be proved to contain potash by its dissolving in dilute nitric acid, with effervescence, and forming nitrate of potash. There is one vegetable salt for which it has been fatally mistaken, namely, the bitartrate of potash, or cream of tartar. This latter is known by its solution not being precipitated by sulphate or muriate of lime; and by its being rendered only milky or turbid on the addition of nitrate of silver. Lime water furnishes a ready means of distinguishing these two salts. It precipitates both of them white, but the precipitate from the bitartrate of potash is re-dissolved on adding to it a small quantity of a solution of tartaric acid, while that from the binoxalate is not re-dissolved.

In Organic Mixtures the process is the same as for oxalic acid itself.

The ACETIC, TARTARIC, and CITRIC acids are not commonly considered to have any poisonous action on the body. At least, so far as I know, there is no case reported of their having acted injuriously in the human subject.

CHAPTER XVI.

POISONING BY THE ALKALIES AND THEIR SALTS.

POTASH, SODA, AND THEIR CARBONATES. PEARLASH, SOAP-LEES.—The *symptoms* produced by these substances when taken in a strong dose, are so similar, that one description will serve for all. It must be observed that cases of alkaline poisoning are extremely rare, and have been, I believe hitherto, the result of accident. The patient experiences, during the act of swallowing, an acrid, caustic taste from the alkaline liquid excoriating the mucous membrane. There is a sensation of burning heat, extending down the œsophagus to the epigastrium. Vomiting is not always observed ; but when it does occur, the vomited matters are sometimes mixed with blood of a dark brown colour, and detached portions of membrane :—this effect depending on the degree of causticity of the liquid swallowed. The surface is cold and clammy :—there is diarrhea with severe pain in the abdomen, resembling colic. The pulse is quick and feeble. In the course of a short time, the lips, tongue and fauces, become swollen, soft and red. *Post-mortem appearances.* There will be strong marks of the local action of the poison on the mucous membrane of the mouth, fauces and œsophagus. It has been found softened, detached and inflamed in patches of a deep chocolate colour,—sometimes almost black. The same appearance has been met with in the mucous membrane of the larynx and trachea. The stomach has had its mucous surface eroded in patches, and there has been partial inflammation. *Period of death.*—The earliest fatal case which I have found reported, is that of a boy, who died in twelve hours after swallowing three ounces of a strong solution of carbonate of potash. In another case which occurred at Yarmouth, in 1835, a child aged three years, took a small quantity of pearlash, which had deliquesced, and died in twenty-four hours. Death was caused in this instance, by the inflammation induced in the larynx, causing an obstruction to the process of respiration. In this respect, the caustic alkalies may destroy life like the mineral acids. But death may be a slow result of the poison. Thus in an instance which was lately communicated to me, a lady swallowed by mistake, one ounce and a half of the common solution of potash of the shops, which contains but very little caustic alkali. She recovered from the first symptoms of irritation; but died seven weeks afterwards, from pure exhaustion, becoming greatly emaciated before her death. Orfila refers to two cases of poisoning by carbonate of potash, in each of which, half an ounce of that substance was taken by mistake for aperient salts. The patients, two young men, recovered from the first effects; but ultimately died, the one three months, and the other four months after the poison had been taken. The secondary fatal effects appear to be due to diarrhea, great irritability of the stomach, loss of the functions of that organ from the destruction of the lining membrane,—and stricture of the œsophagus,—any of which causes may prove fatal at almost any period. The *quantity* of any of these alkaline poisons, required to destroy life, is unknown. *Treatment.*—We may administer freely, water containing acetic acid or citric acid dissolved,—lemon juice, or the juice of oranges. Demulcent drinks, as milk, gruel, or barley-water, will also be found serviceable. Oil has been found useful.

AMMONIA. SESQUICARBONATE OF AMMONIA.—The vapour of strong ammonia is poisonous. It may destroy life by producing violent inflammation of the larynx, and pneumonia. It is often most injudiciously employed to rouse persons from a fit. A case is on record, of an epileptic having died under all the symptoms of croup, two days after the application of strong ammonia, in this way, to the nostrils. A very singular case of recovery from the poisonous effects of this vapour, by Dr. Sanchard, will be found in the Annales D'Hygiène, Janvier 1841.

The solutions of ammonia and its sesquicarbonate produce symptoms, similar to those described in speaking of potash. The only difference observed, is that the sense of heat and burning pain in the throat, fauces and stomach, is much greater. Cases of this description are rare. Dr. Sanchard relates an instance which occurred recently in France, where a boy, only six years old, poisoned his younger sister, by pouring several teaspoonfuls of strong solution of ammonia down her throat. A case is likewise reported where a strong dose of the solution killed a man in *four minutes.* (Christison, 167.) The solution of sesquicarbonate of ammonia, (sal volatile,) is probably more active as a poison, than is commonly supposed. The following case occurred to my knowledge in 1832. A man in a fit of passion, swallowed about five fluid-drachms of a solution of sal volatile. In ten minutes, he was seized with stupor and insensibility; but upon the application of stimulant remedies, he recovered. He suffered for some time afterwards from severe irritation about the fauces and œsophagus. Of the action of the other salts of ammonia on man, nothing is known.

CHEMICAL ANALYSIS.—The three caustic alkalies, potash, soda and ammonia, are known from the solutions of the alkaline earths by the fact, that they are not precipitated by solution of carbonate of potash. They all three possess a powerful alkaline reaction on test paper, which in the case of ammonia, is easily dissipated by heat. Ammonia is immediately known from potash and soda, by its odour and volatility. If the solution in water be very dilute, the odour may be scarcely perceptible. The alkali may then be discovered, provided we have first assured ourselves, by evaporating a portion of the liquid, that potash and soda are absent,—by adding to the solution a mixture of arsenious acid and nitrate of silver. The well-known yellow precipitate of arsenite of silver will be instantly produced. In addition to these characters, ammonia re-dissolves the brown oxide of silver, which it precipitates from the nitrate, while potash and soda do not. The sesquicarbonate of ammonia may be known from other salts by its alkaline reaction, its odour, and its entire volatility as a solid from pure ammonia:—1, by its effervescing on being added to an acid; 2, by its yielding an abundant white precipitate with a solution of muriate of lime;—from the carbonates of potash and soda, among other properties, 1, by its giving no precipitate with a solution of the sulphate of magnesia; 2, from the rich violet blue solution, which it forms when added in excess to the sulphate of copper; 3, by its odour and volatility.

CAUSTIC POTASH and SODA are best known from their respective carbonates by giving a brown precipitate with a solution of nitrate of silver. The carbonates, on the other hand, yield a whitish yellow precipitate. Caustic potash is known from caustic soda by the following characters. 1. Its solution is precipitated of a canary-yellow colour, by bichloride of platina. 2. It is precipitated in granular white crystals, by the addition of an excess of a strong solution of tartaric acid. Caustic soda is not precipitated by either of these tests, which will serve equally to distinguish the salts of potash from those of soda. 3. If we neutralize the two alkalies by dilute nitric acid, and crystallize the liquid on a slip of glass, should the alkali be potash, the crystals will be in the form of long slender fluted prisms; if soda, of rhombic plates. 4. A fine platina wire may be dipped into the alkaline liquid, and then dried by holding it above the flame of a spirit-lamp. In this way, a thin film of solid alkali is obtained on the wire. On introducing this into the colourless part of the flame; if it be potash, the flame will acquire a lilac colour; if soda, a rich yellow colour. This test applies to the salts of the alkalies, but care must be taken that the platina wire is perfectly clean.

The carbonates of potash are known from those of soda by the above tests. The carbonate is known from the bicarbonate of either alkali, by the fact that the former yields immediately a white precipitate, with a solution of sulphate of magnesia, while the latter is unaffected by that test.

In liquids containing organic matter.—Such liquids will possess an alkaline reaction. If the alkali be ammonia, this will be announced by the odour, and it may then be obtained by distillation with or without the addition of a small quantity of sulphuric acid. If the alkali be in small proportion, this can afford no evidence of poisoning; since many animal fluids contain the alkali, and in those which do not contain it, it is easily generated either by spontaneous decomposition, or sometimes even by the heat required for distillation. Should the alkali be in large quantity, this is no evidence of poisoning by it, unless we at the same time discover obvious marks of its local action on the mouth, fauces, œsophagus and stomach. If the organic liquid be highly alkaline, but give out no odour of ammonia, either by itself or on distilling a portion with sulphuric acid, the alkali may be either potash or soda, or their carbonates. The latter would be known by the liquid effervescing on adding a portion to an acid. The organic liquid may be evaporated to dryness, then heated to char the animal and vegetable matter, and the alkali will be recovered from it in the state of carbonate by digesting the residuary ash in distilled water. It has been also recommended to neutralize by muriatic acid, to evaporate, incinerate, and procure the alkali for analysis in the state of chloride. Traces of these alkalies furnish no evidence, since all the animal liquids and membranes yield soda, and many of them potash. In no case will the discovery of the alkalies be any proof of poisoning, unless the marks of their action be apparent in the fauces and stomach.

There are certain salts of potash, to which poisonous effects have been attributed. It will be necessary, therefore, to consider these briefly.

IODIDE OF POTASSIUM. (HYDRIODATE OF POTASH.)—This has been extensively used as a medicinal preparation, but it appears to have given rise in some instances, to alarming symptoms, even when exhibited in small doses; and death has been said to follow its use. The following cases will perhaps best serve to illustrate its effects. A gentleman was ordered by his physician to take three grains of the iodide in a draught of peppermint water three times a day. After the third dose, he felt poorly; and an hour after the fourth dose he was attacked with a violent shivering fit, followed by headache, hot skin, intense thirst, quick and full pulse, vomiting and purging. These symptoms were succeeded by great prostration of strength. In spite of treatment, the purging lasted several days. The effects of the medicine in this case were so violent, although only *twelve grains* had been taken, that there is little doubt, if the patient had taken another dose, he would have been killed. (Med. Gaz. Sept. 3, 1841.)

In October, 1841, a case was reported by Mr. Ericksen to the University College Medical Society, in which very alarming symptoms resulted from the exhibition of only *five grains* of iodide of potassium. There was great difficulty of breathing; discharge from the eyes and nostrils, inflamed conjunctivæ, and most of the symptoms of violent catarrh. The iodide was discontinued, and the patient recovered. Dr. Lawrie found that seven grains and a half of the iodide in three doses, produced in an adult, dryness and irritation of the fauces, great difficulty of breathing and other serious symptoms. In another case, thirty grains in divided doses, caused severe headache and secretion of tears. In two instances, wherein he had prescribed it medicinally in small doses, it was, in his opinion, the cause of death. (Med. Gaz. xxvi. 588.) These cases at least show the necessity of caution in the medicinal use of this substance. The effects may, perhaps, be attributed to idiosyncrasy. Still there seems to be good ground, from the results of experiments on animals, for ranking iodide of potassium among irritant poisons. It has not, so far as I know, caused death, if we except the two cases of Dr. Lawrie, and the case referred to, (antè, p. 39,) which may, perhaps, be regarded as of a doubtful nature. One drachm and a half of the solution has been taken by a young female without destroying life, although it produced very serious symptoms of irritation. (Devergie, Méd. Lég. ii. 536.)

CHEMICAL ANALYSIS.—Iodide of potassium is a white solid salt, crystallizing in cubes, like common salt. It is very soluble in water. In the *solid* state: mix it with a small quantity of peroxide of manganese and moisten the powder with equal parts of strong sulphuric acid and water,—then heat the mass in a glass tube. The purple vapour of iodine is immediately evolved. If the tube be of small diameter the quantity which may be thus easily detected, is exceedingly minute. If the iodide be in *solution*, add to the clear liquid an equal part of a solution of starch, and then a few drops of strong nitric acid. The blue colour of the iodide of farina produced, will show that the salt is an alkaline iodide. This test is extremely delicate. The potash may be detected by decomposing the salt at a high temperature with strong sulphuric acid, when sulphate of potash will result.

In *organic liquids*.—If much coloured, boil with amnial charcoal until the colour is in great part or entirely removed; then add to the liquid a solution of starch in large quantity, and afterwards nitric acid. As a trial test, we may employ a slip of filtering paper soaked in starch, then dipped into the suspected liquid and exposed to the fumes of nitric acid. In this case, the colour of the liquid does not interfere with the experiment. By this process, the iodide may be detected in the urine, when the analyst may not succeed in finding it in the contents of the stomach. If present in organic solids, we must dry them, incinerate them, and lixiviate the incinerated residue, when traces of the iodide may be detected by starch and nitric acid. The following is the result of an experiment. Ten grains of iodide of potassium were dissolved in six ounces of porter, mixed with an ounce of thick starch. The mixture was evaporated to dryness, the residue incinerated and lixiviated with one ounce of water. The solution was neutral. One drop containing one-fiftieth of a grain of iodide, gave a deep pink red colour with starch and nitric acid.

There is no antidote to this poison. It should be removed as speedily as possible by the stomach-pump.

SULPHURETS OF POTASSIUM AND SODIUM. (LIVER OF SULPHUR.)—These compounds are seen as uncrystalline solids of a red or red brown colour. They form yellow solutions in water which have an alkaline reaction and are highly poisonous. No case of poisoning by them has occurred in England; but two fatal cases are reported to have occurred in France. The symptoms were—burning pain in the stomach, vomiting and convulsions. In one case the patient died in about a quarter of an hour, and the stomach and duodenum were found inflamed after death. It was observed that the breath of the patient was tainted with the odour of sulphuretted hydrogen gas.

ANALYSIS.—When *solid*, sulphuretted hydrogen is abundantly evolved, on adding diluted muriatic acid to the powdered sulphuret; and the alkali remains as a chloride. When in *solution*, subacetate of lead gives an intense black precipitate, by which the sulphuret may be identified in the smallest proportion.

NITRATE OF POTASH. (NITRE. SALTPETRE.)—This well-known salt is largely employed in the arts. It is an irritant, but only acts as such when taken in a large dose. It has destroyed life on several occasions. Its effects are somewhat uncertain. An ounce, and even two ounces have been taken without causing very alarming symptoms. (Ed. M. and S. J. xiv. 34.) Tartra denied that it had poisonous properties even in a very large dose, (op. cit. 136,) but cases have occurred which now leave no doubt on the subject.

In one instance quoted by Orfila, an ounce of nitre was taken by a lady in mistake for other salts. In a quarter of an hour, she suffered from nausea, vomiting, and purging, and the muscles of the face were convulsed. The pulse was weak,—the respiration laborious, and the extremities cold, but there was a sense of burning heat and severe pain in the epigastrium. She died in *three hours* after taking the dose. On dissection, the stomach was found highly inflamed, and the membrane detached in various parts. Near the pylorus, the inflammation had a gangrenous character. A large quantity of liquid coloured by blood, was found in the stomach.

My friend, Dr. Geoghegan of Dublin, has communicated to me the following case, which is of recent occurrence. A man took from an ounce to an ounce and a half of nitre by mistake for salts. Severe pain in the abdomen followed, with violent vomiting, but no purging so far as could be ascertained. He died in about *two hours* after taking the salt. On examination, a bloody mucus was found in the stomach,—the lining membrane was of a brownish red colour, generally inflamed, and in parts detached from the coat beneath. None of the poison was detected in the stomach, but its nature was clearly established from the analysis of a portion left in the vessel which had contained the draught.

Poisoning by nitre has been hitherto the result of accident. It is never taken for the purpose of suicide, the popular opinion being, that it is not poisonous; although the above cases show that it destroys life with greater rapidity than is commonly observed in the action of arsenic and corrosive sublimate. It is never likely to be employed by a murderer, since a dose sufficient to kill could not be secretly exhibited.

Two men swallowed, each, one ounce of nitre by mistake for Glauber's salt. They almost immediately experienced a sense of coldness in the course of the spine, trembling of the limbs, with violent vomiting and purging. The stools were bloody. They recovered in the course of a few days. (Casper's Wochenschrift, xviii. 1841.) A case is reported in the same journal, where one ounce of nitre killed a man in thirty-six hours.

Chemical analysis.—See Nitric Acid, (antè, p. 102.)

Bitartrate of Potash. (Cream of tartar. Argol.)—This salt has proved fatal in at least once instance, although it is not commonly regarded as a poison. The case is reported by Mr. Tyson; it occurred in this metropolis in 1837. A man, aged thirty-seven, took four or five table-spoonfuls of cream of tartar. He was seized with violent vomiting and purging. There was pain in the abdomen; thirst, feeble pulse, and the thighs and legs appeared paralyzed. The fluid vomited was of a dark green colour, and the motions, of the colour of coffee-grounds. Death took place in about forty-eight hours. On inspection, the mucous membrane of the stomach and duodenum was found highly inflamed, the cardiac portion of the former being of a deep red colour with some spots of black extravasation. The stomach contained a thick brown fluid, coloured by bile. The whole of the intestinal canal was more or less inflamed.

Chemical analysis.—Cream of tartar is commonly seen in the form of a white powder. It is sparingly soluble in cold water, producing a slightly acid solution. If the powder be heated on platina foil, it is converted to carbon and carbonate of potash; this dissolves with effervescence in acids, and the nature of the alkali is thereby determined. The decomposition of the powder by heat indicates that it is a vegetable acid salt. On adding the aqueous solution to lime water, a white precipitate is formed, which disappears on adding a further quantity of the solution. This proves that the acid is the tartaric. It is known from the simple tartrate of potash by its acidity, and the fact that it is not precipitated by the muriate of lime, while the tartrate is precipitated as tartrate of lime.

In *organic mixtures.*—The salt being comparatively insoluble, may be found as a sediment at the bottom of the liquid. If dissolved, the liquid may be concentrated and alcohol added; cream of tartar is very insoluble in alcohol, and by this means the organic matter may be separated from it. If the liquid were only coloured, animal charcoal should be used to decolorize it.

SULPHATE OF POTASH.—This salt, commonly regarded as inert, has lately given rise to an important medico-legal investigation in France. A lady, about a week after her delivery, took, by the prescription of her medical attendant, about ten drachms of the sulphate of potash in divided doses, as a laxative. After the first dose, she was seized with severe pain in the stomach, nausea, vomiting, purging, and cramps in the extremities. These symptoms became augmented after each dose, and she died in *two hours.* It was supposed that some poison had been given by mistake, but that was not the case, and the question was, whether her death was caused by the sulphate of potash. On inspection, the mucous membrane of the stomach and intestines, was found pale, except the valvulæ conniventes, which were reddened. The stomach contained a large quantity of reddish coloured liquid, which, on analysis, was found to contain only sulphate of potash, and no trace of any common irritant poison. The examiners referred death to the sulphate of potash given in an unusually large dose, whereby it had acted as an irritant poison in a person whose constitution was already much debilitated. (Ann. D'Hyg. Avril, 1842.)

There is no doubt that the most simple purgative salts may, under certain circumstances, destroy life. I have already related a case (antè, p. 3) in which sulphate of magnesia caused death, and gave rise to a criminal charge in this country. It is said that sulphate of potash has in some cases caused vomiting and other serious symptoms, from its containing as impurity, sulphate of zinc. This is easily discovered by adding the ferrocyanate of potash, which precipitates zinc.

CHEMICAL ANALYSIS.—Sulphate of potash is easily known. It is a dry hard salt, soluble in water, forming a neutral solution. This solution if sufficiently concentrated, is precipitated both by tartaric acid and bichloride of platina, whereby potash is indicated; and the presence of sulphuric acid is known by the action of a salt of barytes. In *organic liquids.* This salt being insoluble in alcohol, may have the organic matter removed from it by treating the liquid containing it (previously concentrated) with alcohol. Or the substance containing the salt may be evaporated to dryness and incinerated, when the sulphate may be obtained by lixiviating the calcined residue with distilled water. The sulphate of potash exists naturally in some animal fluids, but only in traces.

Sulphate of Alumina and Potash. (Alum.)—This substance is very commonly known; but it does not appear to have given rise to any accident at least in this country. A singular case occurred in Paris, in 1828, in which the alleged noxious properties of alum were brought into question. A lady swallowed a quantity of calcined alum dissolved in warm water, which had been supplied to her by mistake for powdered gum. The quantity taken was less than half an ounce. She immediately complained of a burning pain in the mouth, throat and stomach. She afterwards suffered from thirst, violent vomiting, and general disturbance of the system, from which she recovered in the course of two or three days. These effects were referred to the alum, and the party who supplied it by mistake, was condemned to a severe punishment. On the case being carried to an appeal, Orfila contended that alum was not a poison; although he admitted that in the calcined state it was a caustic, and in order to establish his opinion of its inertness, he offered to swallow half an ounce on the spot! He referred the symptoms under which the party laboured to some other cause, but on being further questioned, he admitted that a solution of calcined alum was likely to produce more serious effects than common gum, which the party should have taken. The punishment was mitigated. (Ann. D'Hyg. i. 234.)

We must admit the possibility of this substance acting as an irritant, on the same principle on which we admit the irritant properties of salts of a far more innocent character. It is, however, proper to observe, that this salt, given in large doses to animals, does not appear to affect them seriously, and that *three drachms* have been taken by patients at a dose, dissolved in six ounces of liquid, without any inconvenience resulting.

Chemical analysis.—Common alum possesses a peculiar and astringent taste. It easily dissolves in water, forming an acid solution, which crystallizes on evaporation in regular octohedra. Its solution is not affected by ferrocyanate of potash or sulphuretted hydrogen, whereby it is known from the true metallic saline solutions. Its sulphuric acid may be detected by a salt of barytes. On adding potash, a white precipitate of alumina falls down, which is redissolved by adding a larger quantity of the alkali. By this last character, it is known from the alkaline earths which are precipitated from their solutions by potash, but are not redissolved. On adding ammonia in excess, alumina falls down. This may be separated by filtration, and on evaporating the liquid portion, and incinerating the saline residue, it will be found to be sulphate of potash. Calcined alum is a white uncrystalline substance, only partially soluble in water. The quantity dissolved is, however, sufficient to allow its nature to be determined.

Chloride of sodium. (Common salt.)—For the alleged poisonous properties of this substance, see antè, p. 2, and for the chemical analysis, see Muriatic Acid.

Barytes and its salts.—These are undoubtedly poisons, but very little is known concerning their action on the human subject. Pure barytes itself is a caustic alkali, which is not likely to be taken as a poison, seeing that it is rarely met with out of a chemical laboratory. The principal salts are the chloride, nitrate, acetate, and carbonate, the last of which is insoluble in water. The sulphate, from its great insolubility, is said not to be poisonous; but it would be well that this should be established by experiment, since insolubility is no criterion whatever of a substance being inert; although it is often erroneously assumed to be so, and the doctrine of chemical antidotes is founded on this view. Calomel and arsenite of copper are as insoluble as the sulphate of barytes, and yet are known to have a very powerful action on the body.

The only two preparations of barytes that have yet caused death, are the chloride and the carbonate. A case of poisoning by the chloride, will be found antè, p. 74. The symptoms are those of irritation, combined with an affection of the brain and nervous system, since vertigo, convulsions and paralysis, have been remarked among them. In the case referred to, half an ounce proved fatal in two hours. In another instance, one ounce taken by mistake for Glauber's salt, destroyed life in *an hour*. In small doses even, it has been found to affect the system powerfully.

The carbonate of barytes is said to have destroyed life in two cases, in each of which only one drachm was taken; but the following case which occurred to Dr. Wilson, shows that this compound is not so poisonous as the chloride.

A young woman swallowed half a tea-cupful of the powdered carbonate, mixed with water, at a time when she had been fasting for twenty-four hours. There was no particular taste. In two hours, she experienced dimness of vision, double vision, ringing in the ears, pain in the head, and throbbing in the temples, with a sensation of distension and weight at the epigastrium. There was also palpitation of the heart. After a time she complained of pain in the legs and knees, and cramps in the calves. She vomited twice, a fluid like chalk and water. The skin was hot and dry, the pulse frequent, full and hard. These symptoms gradually abated, and she recovered, although the pain in the head and epigastrium continued for a long time. (Med. Gaz. xiv. 448.)

The acetate of barytes would, no doubt, prove an active poison; but it is not much known.

TREATMENT.—The alkaline sulphates, either of soda or magnesia, should be exhibited freely in water; but, unless the patient is seen early, no treatment is likely to avail. The sulphates render the barytes less soluble, and certainly diminish, if they do not altogether destroy its poisonous properties. They will be of little service where the carbonate has been taken. In this case emetics and the stomach-pump may be used. As a chemical antidote to the carbonate, a mixture of vinegar with an alkaline sulphate may be employed. It would of course be improper to administer dilute sulphuric acid, and any other acid would render the poison more soluble.

CHEMICAL ANALYSIS.—A solution of pure barytes possesses an alkaline reaction like potash, soda, and ammonia; but it is known from these three bodies, by its being precipitated white by a solution of carbonate of potash. This last-mentioned agent precipitates equally lime and strontia, but among numerous other characters, barytes is known from lime by sulphuric acid, which precipitates barytes, but not lime. Sulphuric acid also precipitates a solution of pure strontia, but barytes is known from this by the action of a solution of sulphate of lime. This precipitates barytes immediately, but not strontia.

The salts of barytes possess three characters in common: 1. They are precipitated white by sulphuric acid or an alkaline sulphate, even when considerably diluted; those of lime are not precipitated, and those of strontia are very slowly precipitated when the solutions are diluted. 2. Diluted solutions of the salts of barytes are not precipitated by oxalic acid; those of strontia and lime are precipitated, even when much diluted with water. Oxalate of ammonia will throw down the salts of the three bases, unless the solution of the barytic salt be exceedingly diluted, when no precipitate is formed in it. Solutions of the salts of strontia, and lime when equally diluted, are, however, readily precipitated by oxalate of ammonia. 3. The powdered salts of barytes, when burnt on a platina wire in the flame of alcohol, give a greenish yellow colour; those of strontia and lime give a rich crimson red. This experiment applies only to the soluble salts. The acids of the salts are known by their respective tests. The chloride of barium, by the action of nitrate of silver. The nitrate of barytes, by precipitating the solution with sulphate of potash and obtaining nitre from the filtered liquid. The carbonate of barytes by its dissolving with effervescence in diluted nitric acid, and the action of the proper tests on the resulting soluble nitrate. Lastly, the acetate by boiling the solution with diluted sulphuric acid, when acetic acid escapes, easily known by its odour. The solution of this last-mentioned salt is known from the other soluble salts of barytes by its being precipitated only when concentrated by tartaric acid, as well as in a large quantity of water.

In *organic liquids*.—If the salt of barytes be dissolved, a good trial test is diluted sulphuric acid. This gives an abundant white precipitate if the poison be present in any quantity. We may then throw down the whole of the poison by an alkaline sulphate,—separate this by filtration, dry it and incinerate it with the organic matter. In this way, it will be converted to sulphuret of barium, which may be decomposed by washing it with diluted muriatic acid, when chloride of barium, in a state fit for testing, will be obtained.

It is proper to observe, that pure barytes and its salts are very apt to be confounded with subacetate of lead and other compounds of that metal. A clear distinction consists in this: the salts of lead are blackened by hydrosulphuret of ammonia—those of barytes are not.

STRONTIA and LIME have no interest for the medical jurist. Lime is said to have destroyed life in one instance; both of these bases, as well as their salts, may have an irritant action. Nothing, however, is known of their effects on man, and so far as experiments on animals go, they have not the directly poisonous action of barytes and its compounds. In medico-legal analysis, their salts may be mistaken for those of barytes, as they are in many respects similar. Great caution should therefore be used, when a mixture alleged to be poisoned with a salt of barytes, is presented for examination. For a summary of the most remarkable chemical differences in respect to the action of liquid tests, see pôst,—table of alkaline poisons.

This concludes the account of the non-metallic inorganic irritants. We shall now pass to the description of the metallic irritant poisons, which it may be observed are distinguished from the preceding by the fact that they are all precipitated by sulphuretted hydrogen gas, or by the hydro-sulphuret of ammonia.

CHAPTER XVII.

ON POISONING BY ARSENIC.

THE term WHITE ARSENIC is commonly applied to the arsenious acid of chemists. Arsenic acid is another compound which is highly poisonous, but has never, so far as I know, been used for the purposes of suicide or murder. YELLOW ARSENIC, or orpiment, is the sesquisulphuret of chemists. This is also poisonous, apparently because it contains a large portion of arsenious acid, which has not been decomposed by sulphur. This has been on two or three occasions criminally used as a poison.

White arsenic, or arsenious acid, is that preparation which chiefly requires the attention of the medical jurist. In the years 1837-8, there were one hundred and eighty-five cases of poisoning by this substance, the greater number of which were cases of suicide and murder. Considering the great destruction of life which is continually taking place from arsenic, it is to be regretted that a substance so little required for any lawful purpose, should be allowed to be sold in so free and open a manner. At almost any druggist's or grocer's shop throughout the kingdom, enough may be procured for a penny to destroy the lives of fifty persons! It is equally sold to men, women, and children upon the most absurd and trivial pretences; and the numerous murders and suicides annually committed by means of this poison, clearly prove that the precautions as to its sale, if observed at all, are futile and ineffectual. Lately, in the neighbourhood of London, arsenic was sold by a druggist to a mere youth at a boarding-school; the boy took it and died. The druggist escaped, with the opinion of the jury, that his conduct was "culpable;" on the Continent, it is most probable he would have been heavily fined and imprisoned. The sale of alcohol and other fiscal articles is restricted, and there is no doubt that much crime might be checked, and many lives saved by placing strong legal restrictions on the sale of arsenic and active poisons generally. It appears from the table that more than one-third of all the fatal cases of poisoning in England are occasioned by arsenic.

White arsenic is commonly seen under the form of a white powder, or in opake masses resembling enamel. It is called an acid from its power of combining with alkalies, but it possesses a very feeble acid reaction when dissolved in water. It is often described as having an acrid *taste*, but this appears to be an error; a small quantity of it has scarcely any appreciablo taste, a fact which may be established by direct experiment. It would also appear from numerous cases on record, that it has been unconsciously taken in large quantities, in all descriptions of food, without exciting the least sensation on the tongue. Most of those persons who have been criminally or accidentally poisoned by arsenic, have not been aware of any taste in taking the poisoned substance. It is due to Dr. Christison to state, that he was the first who clearly exposed the error into which Orfila had fallen in describing the taste of white arsenic, as "acrid and corrosive,"—an error which has had its influence on the medical evidence given in numerous cases of arsenical poisoning during the last half century.

Arsenic is an irritant poison: it does not seem to possess any *corrosive* properties, i. e., it has no chemical action on the animal tissues, and the changes met with in the alimentary canal of a person poisoned by it, are to be referred to the effects of the inflammation excited by the poison, and not to any chemical action. I have not found that arsenic produces any effect on dead mucous membrane, like those poisons which are properly called corrosive. In an important case (Waring's,) tried at the Leicester Lent assizes, 1842, the medical witnesses were closely pressed to say whether arsenic was or was not a corrosive poison; the deceased having been killed by arsenic in a few hours, and the changes in the stomach being unusually well marked. They properly referred these changes to the violence of the inflammation, and not to the chemical action of the poison.

The *solubility* of this substance in liquids is a frequent question on trials. The action of water is materially influenced by circumstances. I have found by numerous experiments, (Guy's Hospital Reports, No. 4,) that hot water cooling from 212° on the poison in powder, dissolves about the 400th part of its weight. This is in the proportion of nearly one grain and a quarter of white arsenic to about one fluid ounce of water. Water boiled for an hour on the poison and allowed to cool, holds dissolved the 40th part of its weight, or about twelve grains to one ounce. Cold water allowed to stand for many hours on the poison, does not dissolve more than from the 1000th to the 500th part of its weight; i. e., one-half gr. to one gr. of arsenic to nearly one fluid ounce of water. The presence of organic matter in a liquid, considerably impairs its solubility. Thus, hot tea or brandy will not dissolve more than one-half gr. to the fluid ounce. Liquids, which are at all viscid or mucilaginous, may suspend the poison in almost any quantity, but in these cases it cannot be said to be dissolved. The solubility of arsenic is a matter of frequent medico-legal inquiry. (See the important case of the Queen v. Hunter, tried at the Liverpool Lent Assizes, 1843:—two medico-legal reports of which have been published, the one by Mr. Holland and the other, by Mr. Dyson of Manchester.) It is often necessary to determine whether the quantity taken was sufficient to kill. In reference to its solubility in cold water, I have found that where the quantity dissolved was not more than one-half gr. to one ounce, i. e., about the 1000th part—the solution had neither taste nor any acid reaction whatever. The proportions are here stated in round numbers.

Symptoms.—These will vary according to the form and dose in which the poison has been administered. The *time* at which they come on is generally from half an hour to an hour after the poison has been swallowed. This is the average period. I have known them to appear in a quarter of an hour. Dr. Christison mentions one instance in which the symptoms began in eight minutes; but in the case of Lofthouse, tried at the York Lent assizes, 1835, the symptoms were proved to have attacked the deceased, while he was in the act of eating the cake in which the poison was administered. On the other hand, in an instance reported by Orfila, the symptoms did not show themselves for five hours. In the opinion of Dr. Christison, the symptoms may be retarded by sleep. (See antè, p. 32.)

The individual first experiences faintness, nausea and sickness, with an intense burning pain in the region of the stomach, increased by pressure. The pain in the abdomen becomes more and more severe; and there is violent vomiting of a brown turbid matter mixed with mucus and sometimes streaked with blood. These symptoms are followed by diarrhea, which is more or less violent. There is a sense of constriction, with a feeling of burning heat in the throat, often accompanied by intense thirst. The pulse is small, very frequent, and irregular, sometimes wholly imperceptible. The skin is cold and clammy in the stage of collapse, at other times it is very hot. The respiration is painful from the tender state of the abdominal parietes. Before death, coma sometimes supervenes with tetanic convulsions and spasms in the muscles of the extremities.

Such is the ordinary character of the symptoms in an acute case of arsenical poisoning, i. e. where from half an ounce to an ounce of the poison has been taken; but should the person recover from the first effects, there will be inflammation of the conjunctivæ, with suffusion of the eyes, and intolerance of light,—a condition which is, however, often present with the early symptoms above described. There is also irritation of the skin, accompanied by an eruption, which has been called eczema arsenicale; paralysis and other symptoms of nervous disorder. Exfoliation of the cuticle and skin of the tongue has likewise been witnessed (case of the Turners, 1815, Marshall 119.) Salivation is said to have followed, where small doses of the poison have been given for a length of time. Strangury and jaundice have also been observed. (Marshall on Arsenic, 44. 111.)

The whole of these symptoms may not be met with in every case. Thus the pain, which is usually excruciating, like a fire burning within the body, is sometimes absent. In a well-marked case of poisoning which occurred in October, 1839, from one ounce to two ounces of arsenic were taken; there was no pain except of the most trifling character just before death. It has been supposed that this symptom was absent where the dose was large; but a case occurred in Guy's Hospital in 1836, where only forty grains had been taken, and the patient died without complaining of pain. There are many similar cases on record. The symptoms of alvine irritation are seldom wanting, or there is vomiting, if there should be no purging. In one case of criminal poisoning by arsenic, in which I was consulted by Mr. Veasy, which was tried at the Bedford Spring assizes, in 1842, there was neither vomiting nor purging. The quantity of poison taken must have been very small. Great thirst is a common symptom, but this is sometimes absent. It is necessary for a medical jurist to attend to these anomalies, as otherwise the symptoms of arsenical poisoning may be easily mistaken for those of disease.

Post-mortem appearances.—The striking changes produced by arsenic, are generally confined to the stomach and intestines. They are commonly well marked in proportion to the largeness of the dose and the length of time which the individual has survived after taking the poison. Our attention must first be directed to the stomach. Arsenic seems to have a specific effect on this organ; for, however the poison may have entered into the system, whether through a wounded or ulcerated surface, or by the act of deglutition, this organ has been found inflamed. Inflammation of the stomach cannot, then, be always regarded as dependent on the local irritant action of the poison on that organ. A case is reported in a late number of Rust's Magazin, where a man covered his head with arsenic in powder, to act as a depilatory. He was affected with the usual symptoms of arsenical poisoning, excepting diarrhea; and he died on the twentieth day. The interior of the stomach, as well as the lower part of the æsophagus, was generally inflamed.

The mucous membrane of the stomach is commonly found red and inflamed; the colour, which is sometimes of a dull or brownish red, becomes brighter on exposure to the air; at other times it is of a deep crimson hue, interspersed with black-looking striæ of altered blood. The redness is usually most strongly marked at the greater extremity; in one case it may be found spread over the whole mucous surface, giving to it the appearance of red velvet,—in another it will be chiefly seen on the prominences of the rugæ. Blood of a dark colour is effused in various parts between the rugæ, or beneath the lining membrane, an appearance which has been mistaken for gangrene. The stomach often contains a mucous liquid of a dark colour tinged with blood. The coats are sometimes thickened in patches, being raised up into a sort of fungous-like tumour, with arsenic imbedded in it,—at other times they have been found thinned. The mucous membrane is rarely found ulcerated, and still more rarely gangrenous. Perforation of the coats is so uncommon a result of arsenical poisoning, that there are only three instances on record. The duodenum and rectum are those parts of the intestines which have been generally found inflamed; and traces of inflammation are occasionally seen in the pharynx and œsophagus. The mucous glands of the stomach have been found enlarged; but this is by no means an unusual morbid appearance without reference to poisoning. Various morbid appearances are said to have been met with in the lungs, heart, brain and urinary organs; but they do not appear to be characteristic of arsenical poisoning. It is undoubtedly to the stomach and intestines, that a medical jurist must look for the basis of medical evidence in regard to post-mortem appearances.

A witness is often asked in a court of law how long a time is required after the taking of the poison for the production of these well marked appearances in the stomach, more especially of inflammation of the mucous membrane. On this point I am enabled to present the following facts. In a case that occurred to Mr. Thompson of Nottingham, half an ounce of the poison was taken; the patient died in six hours, and the stomach was found uniformly red and inflamed. In another that occurred to Dr. Booth of Birmingham, the same quantity of arsenic was taken; the patient died in six hours and a half: on inspection the œsophagus was inflamed, and the whole internal surface of the stomach was of an intense scarlet colour; and there was redness and increased vascularity of the duodenum, jejunum and ileum. In Waring's case already referred to, (p. 136,) where but a small quantity of arsenic could have been taken, the whole of the stomach and intestinal canal was found highly inflamed, although the deceased could not have survived *four hours.* Mr. Foster of Huntingdon has favoured me with an account of three cases in which the poison was taken at the same time; and death occurred in one, a child, at the end of *two hours;* in the second, an adult, at the end of *three hours and a half;* and in the third, after the lapse of about six hours. In all of these, the stomach was found highly inflamed, and in the one that proved fatal in two hours, the mucous membrane had a vermilion hue. This last I believe to be the shortest period at which inflammation of the stomach from the effects of arsenic, has been met with.

Another question put to a witness may be this,—What period is required for ulceration of the mucous membrane to take place, as an effect of this poison? If arsenic has destroyed life with unusual rapidity, and the stomach is found ulcerated, an attempt may be made to refer this ulceration to some other cause. (Guy's Hospital Reports, Oct. 1841, p. 283.) Dr. Christison remarks that ulceration is hardly to be looked for unless the patient has survived two days. In the case of Rhymes, which was the subject of a criminal trial in 1841, (G. H. R. suprà,) I found ulceration of the mucous membrane, although the deceased survived the effects of the poison only ten hours. The deposition of the arsenic in and around the ulcers, as well as the appearance of recent inflammation about them, left no doubt that they had been produced by the poison, and were not owing to previous disease, as it was attempted to be urged in defence. When no arsenic is found in the stomach, a defence of this kind will carry with it considerable plausibility. In Waring's case, (anté, p. 136,) a medical witness was questioned upon this point. The deceased died from the effects of arsenic in *four hours;* the coats of the stomach were found ulcerated, but no poison could be detected in the organ. The witness admitted on cross-examination that it was contrary to all experience that ulceration should be occasioned by an irritant poison in less than four hours; but he nevertheless very properly contended that this was the true cause. In short, we must, on such points, be guided by observation; and one case of this kind, is sufficient to place the possibility of ulceration being produced by arsenic within a few hours, beyond all question.

But are the stomach and intestines always found inflamed in cases of poisoning by arsenic? The answer must be decidedly in the negative. At the trial of M'Cracken, at the Derby Autumn assizes, in 1832, for killing his wife with arsenic, the fact of poisoning was clearly established, and a large quantity of arsenic was found in the stomach of the deceased; but there was no appearance of inflammation, either in that organ or the intestines. In a late number of Rust's Magazin, I find the two following cases.

> A servant girl had some arsenic administered to her in chocolate. She was seized with nausea and violent pain in the stomach, and died the same evening. On inspection there was no remarkable vascularity or inflammation of the stomach;—but arsenic was found in the duodenum. A man was taken ill with vomiting and violent pain in the abdomen after partaking of some soup, and he died from symptoms of poisoning. On inspection, the mucous surface of the stomach presented no morbid change, with the exception of slight redness about the cardia. Arsenic was found in the contents of the intestines.

Occasionally the appearances are so slight, that were not the attention of the examiner specially directed to the fact of poisoning, they would be passed over. These singular cases appear to show, that arsenic does not exert any local action of a chemical nature, like a corrosive, on the stomach; for the action of corrosives takes place on mere contact, without reference to the state of constitution or the quantity of poison taken. Medical evidence of poisoning from post-mortem appearances, is in such cases entirely wanting;—they are not very common, but still they show, that unless great care be used in forming an opinion, a case of arsenical poisoning may be overlooked. They teach this important fact in legal medicine, that the non-existence of post-mortem changes, is no proof that the party has not died from the effects of arsenic.

It is worthy of remark in relation to the known antiseptic properties of arsenic, that the parts specially affected by this poison, (the stomach and intestines,) occasionally present the well-marked characters of irritant poisoning for a long time after death. This was established in the case of the Queen v. Dazley, tried at the Bedford Summer assizes, July, 1843. The prisoner was convicted of poisoning her husband with arsenic, upon evidence obtained by the exhumation and examination of the body six months after interment. The stomach and intestines were the only parts of the body undecomposed. This case presents many important subjects for reflection to the medical jurist; as for example, the substitution of arsenic for medicine,—the length of time after death at which good evidence may be obtained from the body,—the fact of another person labouring under symptoms of poisoning by arsenic, who had accidentally partaken of the supposed medicine—and lastly, the evidence from the death of an animal which had swallowed some of the matter vomited by the deceased.

QUANTITY REQUIRED TO DESTROY LIFE.—This is also an important medico-legal question. According to a case quoted by Dr. Christison, the smallest fatal dose on record, in an adult, is stated to have been *thirty* grains of the powdered white arsenic: the man died in six days. But undoubtedly a much smaller quantity than this, would kill. Facts of this description, can of course only be elicited by accident; as in cases of suicide or murder, so much more of the poison, than is necessary, is commonly taken. The smallest fatal dose of arsenic in a state of solution, is stated to have been *four grains and a half*—the child who took it, died in six hours. In Waring's case, it was highly probable from the medical evidence that the deceased, an old woman of seventy, was killed by *four* grains. In a case that lately fell under my notice, I have reason to think a young lady was killed by eating a portion of cake which could not have contained more than *four* grains of arsenic, and probably less than three grains. There is no doubt that very small doses of this poison are capable of producing serious effects; and that some constitutions may be more affected by it than others. Dr Burne has reported the case of a young female, who took in divided doses in three days, one-fifth of a grain of arsenic. Symptoms of inflammation of the stomach and alarming symptoms of a nervous character appeared, which rendered a discontinuance of the medicine absolutely necessary.

The following case occurred in London, in October, 1839. At a large dinner party, it was observed that three persons, who had partaken of the port-wine on the table, were seized with symptoms of poisoning. The wine was suspected to contain poison, and it was sent to me for examination. It was clear, of the usual colour and odour, and possessed all the characters of good wine; but there was a small quantity of a reddish white sediment at the bottom of the bottle. From the account of the symptoms, the wine was suspected to contain arsenic:—this was found to be the case, and the quantity of poison dissolved, amounted to about 1.2 grain in each fluid ounce. The following were the facts. A child aged sixteen months, took a quantity of the wine containing about one-third of a grain of arsenic. In twenty minutes this child became sick, vomited violently for three hours, and then recovered. A lady, aged fifty-two, took a quantity of wine, containing rather less than *two grains* of arsenic. In about half an hour, she experienced faintness. Violent vomiting came on and lasted four hours, but there was no pain. She then gradually recovered. A gentleman, aged forty, took a quantity of the wine containing rather more than *two grains* of the poison The symptoms in him were similar, but more severe; and had he taken another glass of the wine, it is probable he would have been killed. It may be proper to observe, that although this wine was perfectly saturated with arsenic, not the least taste was perceived by any of the parties.

This case shows that two grains of arsenic have been taken without causing death: and I think, from the symptoms produced, we shall be warranted in asserting, that a dose of three grains, and upwards, is likely to prove fatal to an adult, and a much smaller dose might prove fatal to a child. A medical jurist must remember that persons have recovered after having taken very large doses of this poison. A case is reported, in which sixty grains were taken by a physician, who recovered without suffering very severely. (Med. Gaz. xi. 771.) In another instance, a person recovered after having taken half an ounce of arsenic. The stomach-pump was not used, and the arsenic appears to have been carried off by vomiting and purging. Cases of recovery where so large a dose has been taken, are not very common. (Med. Gaz. xix. 238.) But a case is reported where an ounce was taken, and the patient recovered, under no other treatment, than the exhibition of magnesia and sulphate of zinc. (Christison, 321.)

PERIOD AT WHICH DEATH TAKES PLACE.—Large doses of arsenic commonly prove fatal, in from eighteen hours to three days. Probably, the average time at which death takes place, is twenty-four hours. But the poison may destroy life within a much shorter period than this. There are many cases reported in which death has taken place in from three to six hours. It is singular that a few years since, observations were so limited, that it was thought to be impossible for arsenic to destroy life in a shorter period of time than seven hours! (see antè, p. 50, Russell's case;) and this rapidity of death was actually considered as a medical fact, which in some measure tended to negative the allegation of death from arsenic. One of the most rapidly fatal cases on record, I believe to be that which occurred to Mr. Foster, (antè, p. 139.) This gentleman satisfactorily ascertained that the subject, a child under three years of age, died within *two hours* from the effects of arsenic. The quantity taken could not be determined: but I shall presently adduce some facts to show that the time at which death takes place, is not strictly dependent on the quantity of poison taken. Dr. Borland informed me of the case of a woman where death took place, with equal rapidity. Two ounces of arsenic were taken and the patient died in less than *two hours* afterwards in a fit of syncope. The case was remarkable in other points:—there was neither pain, vomiting, nor diarrhea. In these instances of rapid death the brain and nervous system have been observed to be frequently affected;—the patient suffering from narcotism and convulsions: but this by no means implies that symptoms of irritation are always absent. A case was communicated to the London Medical Review, (April 1811, p. 188,) by Mr. Soden of Coventry, which shows, that with a large dose of arsenic and rapid death, there may be violent symptoms of gastric irritation, and few or no symptoms indicative of nervous disorder. The case is otherwise remarkable from the enormous quantity of poison taken. A man aged twenty-two, purchased seven ounces of finely-powdered arsenic, and swallowed, between seven and eight o'clock in the morning, not less than four and probably six ounces of the poison. In about half an hour he was found vomiting;—there was severe pain in the abdomen, rapid pulse, and slight convulsions of the legs. In two hours, diarrhea supervened, and there was constant inclination to pass urine:—the pain in the bowels became most intolerable,—the convulsive motions of the limbs more frequent, and the pulse more feeble, but still very quick. According to the antidotal doctrines, at that time prevalent, sulphuret of potash (potassium,) was largely exhibited to him. He died in *less than four hours,* "after a dreadful fit of convulsive laughter," his limbs becoming suddenly rigid. In this case, there appear to have been no comatose symptoms whatever. On inspection, the stomach was found highly inflamed, "the mucous coat looked as though it had been beautifully injected," and two ounces of arsenic were found in the cavity of this organ.

We have here an instance, which occurred in March 1810, of arsenic destroying life and producing excessive inflammation in less than four hours: and yet at a criminal trial, sixteen years afterwards, (Lewes assizes, 1826,) it was a debated question with some of the medical witnesses, whether it was possible for a person to die from the effects of arsenic in less than seven hours! and respectable authorities were actually quoted against this view. Such is the danger of a criminal court relying for medico-legal facts of this description, upon the personal experience of witnesses.

An interesting case has been recently published by Dr. Dymock. A girl aged twenty, took two ounces of powdered arsenic, and died in less than two hours and a half afterwards. There were no comatose symptoms:—the girl was sensible to the last, and she had vomited violently. The mucous membrane of the stomach was covered with bright patches of a scarlet colour. (Ed. Med. and Sur. Jour. April 1843.)

With respect to the effect of quantity, I have known one case prove fatal in fifteen hours where forty grains had been taken; and in another, where an ounce (twelve times the above quantity) had been swallowed, the patient did not die for seventeen hours. Both patients were females of about the same age. It is a common opinion that large doses only, kill with great rapidity; but that is not uniformly observed. In one instance, two ounces of the poison destroyed life in three hours and a half; but in another case (Waring) a dose of four or five grains killed a person in four hours. It is obvious that a patient who recovers from the first effects, may still die from exhaustion or other secondary consequences, many weeks after having taken the poison.

Treatment.—If vomiting does not already exist as a direct effect of the poison, sulphate of zinc may be exhibited, and the emetic effects promoted by mucilaginous drinks, such as linseed tea. When sulphate of zinc cannot be procured, a good substance for an emetic is powdered mustard, in the proportion of from one to two teaspoonfuls, in a glass of water, administered at intervals. A saponaceous liquid, made of equal parts of oil and lime-water, may also be given. While this invests the poison, the lime acts in some degree as a chemical antidote; although as arsenic is usually taken in the form of a coarse powder, and is very little soluble, chemical antidotes are not of much use. The stomach-pump may be usefully employed; but unless the patient is seen early, remedial means are seldom attended with success. I have known death to occur in a case where every particle of poison was found, on subsequent examination, to have been removed from the stomach. There are many instances of recovery on record, in which the arsenic appears to have been early ejected by constant vomiting and purging. The recovery has, however, been commonly attributed to the supposed antidote. Of late years the hydrated sesquioxide of iron has been very strongly recommended as a chemical antidote in poisoning by arsenic. This is prepared by precipitating persulphate of iron by ammonia, and washing the precipitate: it is used in the moist or hydrated state. There is great difference of opinion on the efficacy of this substance. It is supposed to act by combining with the arsenious acid to form an insoluble arsenite of iron; but it has been clearly proved by the experiments of Taddei and others, that the arsenite of iron, like the arsenite of copper, is a poison; and those who advocate its use, admit that a much larger quantity of oxide than is necessary to form the arsenite of iron, is required for any antidotal effect to follow. Dr. Brett found in his experiments, and I have ascertained the same point, that where even eight or ten parts of the hydrated oxide are mixed with one of the poison in a perfect state of solution, the arsenic is not entirely thrown down; but may still be detected in the liquid by the usual tests. Dr. Maclagan of Edinburgh states, that it requires twelve parts of oxide to neutralize one of arsenic; therefore something more is necessary than the formation of an insoluble arsenite of iron, admitting that this compound is really produced. According to this view, if an ounce of arsenic has been swallowed, and none of the poison ejected, twelve ounces at least of the hydrated oxide should be given immediately in order to produce any good effects; and this is on the assumption that the poison is in a state of perfect solution in water! But as arsenic is almost always taken in the form of powder, and is very little soluble in water, it appears to me that all experiments performed with the hydrated oxide of iron on a boiled and filtered solution of the poison, have not the least practical bearing on the question. In order to ascertain whether this substance could really be considered a *chemical* antidote under the circumstances in which arsenic is commonly taken, I mixed a quantity of the hydrated sesquioxide of iron, obtained by precipitating with ammonia six ounces of a strongly saturated solution, of the persulphate of iron with forty grains of finely-powdered arsenious acid, adding about two ounces of a mixture of albumen and water, as a substitute for the mucus of the stomach, and making the whole quantity up to sixteen ounces with distilled water. The mixture was well agitated, and kept at a temperature of about 75° for a week, at the end of which period the greater part of the arsenic still remained undissolved at the bottom of the vessel. As this poison is frequently taken in coarse lumps, and almost always in very large quantities, it is not possible to conceive, under these circumstances, that oxide of iron should have any chemical action upon it, of an antidotal nature.

If the poison were swallowed in the state of a filtered aqueous solution, the oxide of iron might combine with it; but then its antidotal effects are so imperfect, that unless administered instantly in a very large proportion, it could be of no benefit; for it is obvious that in such a state of solution, arsenic would act with very great rapidity. Numerous recoveries are said to have occurred under the use of this alleged remedy, but so far as I have been able to ascertain, in severe cases, emetics and the stomach-pump were also freely used; and in the lighter cases, recovery would probably have equally taken place without it. Recoveries were said to take place formerly, under the use of the alkaline sulphurets, or of carbonate of magnesia. In the case of the Turners (1815), five persons recovered from the effects of arsenic, under treatment which we should now look upon as highly injurious. (Marshall on Arsenic, 106.) It appears probable that in this, as in other cases of poisoning, too much importance has been attached to the effect of the supposed antidote, and too little assigned to the efforts of nature and the simultaneous employment of emetics and the stomach-pump. It is upon the use of these evacuants that we must chiefly rely, in treating a case of arsenical poisoning. Viscid or mucilaginous liquids may be also freely exhibited, as these will serve to suspend the poison mechanically, and to sheathe the coats of the stomach from its action.

In order to test further, the alleged value of the oxide of iron as a chemical antidote the following experiment was performed. Sixty grains of finely powdered arsenic were mixed with the hydrated oxide of iron, recently precipitated from eight ounces of a saturated solution of persulphate by ammonia,—a sufficient quantity of this alkali being left to produce a strong reaction on test paper. The whole quantity of water was made up to twenty fluid ounces. This mixture was frequently agitated and kept for six hours at a temperature of 98° in a water-bath. It was allowed to remain for a fortnight, being occasionally shaken during that time. On examination it was found, that a large portion of the powdered arsenic still remained undissolved and uncombined with the oxide of iron at the bottom of the vessel. On drying a portion of this sediment on plate glass, the arsenious acid was easily detached from the oxide of iron. No portion of arsenic was held dissolved in the liquid, which was no longer alkaline. Reinsch's test, however, showed that some part of the arsenic was either mechanically mixed or chemically combined with the oxide; and there is no doubt that so much as had been dissolved by the water and the alkali, had become precipitated. The quantity of oxide of iron here used, was very great. This and other similar experiments, appear to me to show, that the oxide of iron does not possess the power of combining with *powdered arsenious acid*, the only form in which we commonly have to deal with the poison, in a way to act as a chemical antidote; and that if recoveries have really taken place from its use, it must have some other mode of operation.

It has been objected to the use of the oxide of iron, that it is liable to contain arsenic, and might thereby give rise to embarrassment in the analysis. (Schafhaeutl.) This objection was raised in the celebrated case of Laffarge, tried in France a few years since. I have examined several specimens of oxide of iron by Reinsch's test, but have found no arsenic in them.

CHEMICAL ANALYSIS.—In the *simple state*, as a *solid*, white arsenic may be identified by the following properties: 1. A small quantity of the powder, placed on platina foil, is entirely volatilized at a gentle heat in a white vapour. Should there be any residue, it is impurity; sometimes plaster of Paris is said to be mixed with it. The quantity of fixed impurity present, may in this way be easily determined. If a small portion of the white powder be very gently heated in a glass tube of narrow bore,—it will be sublimed, and form a ring of minute octohedral crystals, remarkable for their lustre and brilliancy. It will be observed in these experiments, that white arsenic in vapour possesses no odour. 2. On boiling a small quantity in distilled water, it is not dissolved, but it floats in a sort of film, or becomes aggregated in small lumps at the bottom of the vessel. It requires long boiling, in order that it should be dissolved and equally diffused through water. On adding a few drops of caustic potash to the water, it is entirely dissolved, forming a clear solution of arsenite of potash. 3. When a portion of the powder is treated with a solution of hydrosulphuret of ammonia in a watch-glass, there is no change of colour, as there is with most metallic poisons, on heating the mixture, the white powder dissolves; and on continuing tho heat until the ammonia is expelled,—a rich yellow or orange-red film is left, (sesquisulphuret of arsenic,) which is soluble in all alkalies. 4. When a small portion, i. e. from one-fourth to one-twentieth part of a grain, is heated with some reducing agent containing carbon, in a glass tube about three inches long and one-eighth of an inch in diameter, it is decomposed; a ring of metallic arsenic of an iron-grey colour is sublimed and deposited in a cool part of the tube At the same time, there is a perceptible odour resembling that of garlick, which is possessed by metallic arsenic in the state of vapour. This *odour* was at one time looked upon as peculiar to arsenic, but no reliance is now placed on it, as a matter of medical evidence; it is a mere accessary result. Many mistakes were formerly made in respect to this odour. Thus, we find it stated to have been perceived under circumstances in which it could not have been produced. (Marshall on Arsenic, 90, ed. 1817.) It was not then known, that white arsenic (arsenious acid) possessed no odour in the state of vapour. In this experiment, there are commonly too rings deposited in the tube, the upper of which has a brown colour, and appears to be a mixture of finely divided metallic arsenic and arsenious acid. It has been regarded by some as a suboxide, more volatile than the metal. Various reducing agents have been proposed; for example, charcoal, black-flux, calcined cream of tartar,—the oxalate of lime or soda—the formate of soda; but that which I have found most convenient is the incinerated residue of crystallized acetate of soda, which consists of carbon and carbonate of soda. In order to make it, it is merely necessary to incinerate the dried crystals of the acetate in a close vessel; it may be kept for years without change. The proportion in which it should be employed in the reduction, is about two or three parts of flux to one of white arsenic.

If it be necessary to determine the weight of the sublimate, the glass tube should be filed off closely on each side of the metallic ring, and weighed; the sublimate may then be driven off by heat, and the piece of glass again weighed. The difference or loss represents the weight of the sublimate. These sublimates are remarkably light, and require a delicate balance. I found in one experiment a large sublimate to weigh no more than ·08 gr. By heating the piece of tube in another of larger diameter, the metallic arsenic in being volatilized, forms octohedral crystals of arsenious acid. When the quantity of arsenious acid is so minute as to be scarcely ponderable, it would be advisable to employ for its reduction, finely powdered and dry charcoal, since the alkali in the soda-flux would retain the whole or the greater part of the arsenic in combination. The minute quantity of arsenious acid should be dropped into a dry and warm tube, not more than the eighth or the tenth of an inch in diameter and the charcoal well dried, dropped on it in the proportion of three or four times its bulk. The upper part of the charcoal should be brought to a high temperature before the arsenic is heated. In this way, distinct arsenical sublimates may be procured weighing considerably less than the 1000th part of a grain. The delicacy of this test cannot be estimated by the weight of the sublimate, but by the weight of the arsenious acid, on which we can operate.

Objections.—Corrosive sublimate is volatile like white arsenic, but it differs from it in all its other properties. It is very soluble in water, insoluble in potash, which turns it of a yellow colour,—while hydrosulphuret of ammonia turns it black. Indeed it may be said that there is no substance but arsenic which possesses the three first characters mentioned; they should, however, be taken together. With regard to the fourth character, namely, the production of a metallic sublimate, there have been numerous objections: 1. The glass itself may acquire a black metallic lustre by heat from the reduction of the oxide of lead contained in it. This is always the case when the tube is held too much in the body of the spirit-lamp flame instead of over the point. This metallic stain differs in appearance from arsenic; it is fixed, while the arsenical sublimate is volatile by heat, and convertible to octohedral crystals of arsenious acid. 2. Charcoal may give a dark colour to the tube, but it is not advisable to employ this substance, unless the quantity of arsenious acid be very minute; besides the stain of charcoal is fixed, and has no metallic lustre like that of arsenic. 3. Arsenic is said to be contained in glass, and it was supposed that it might be sublimed by heat; that, however, is impossible: arsenic is used in the manufacture of glass, but it is entirely volatilized during the process. 4. Cadmium is a metal which is said to form a metallic sublimate like arsenic. The oxide of cadmium may be reduced by a similar process, but the metallic sublimate is wholly different from that of arsenic; it has a tin-like lustre, and is generally fringed with a brown margin of reproduced oxide. There is no odour of garlick during the reduction of oxide of cadmium, and on heating the metallic ring, it is not wholly volatilized like arsenic, but converted to a ring of brown oxide. Oxide of cadmium is of a brown colour,—it cannot be volatilized on platina by the heat of a spirit-lamp; it is quite insoluble in potash, but easily dissolved by nitric acid. If there were no perceptible difference in the sublimates produced by the two bodies, these characters would at once form a clear distinction between them. Oxide of cadmium is moreover a very rare substance, it is difficult to meet with it. 5. Mercury forms a sublimate; but in white silvery globules, quite distinct from the dark iron-grey lustre of arsenic. Neither antimony nor zinc can be volatilized from any of their preparations in a metallic state, by the heat of a spirit-lamp.

The test of reduction with the most simple precautions, is, therefore, when thus applied, conclusive of the nature of the substance under examination. It is advisable, although not absolutely necessary, that we should apply the three foregoing tests to the white powder, before attempting to extract the metal from it.

With respect to the other properties of arsenic it may be remarked,—that it is very soluble in boiling muriatic acid, and by this means it may be separated from the sesquisulphuret or orpiment, which is not dissolved by that acid. The solubility of arsenious acid in muriatic acid, aids the deposition of the metal on copper in a way to be presently explained. It is not dissolved by nitric acid, but is oxidized by it on long boiling, and converted to arsenic acid; and lastly, it is soluble in alcohol, and is not precipitated by this reagent from liquids in which it is dissolved. The presence of neutral salts does not appear to affect its solubility in water.

Arsenic in solution in water.—The solution is clear, colourless, possesses scarcely any perceptible taste, and has a very faint acid reaction. In this state, we should first evaporate a small quantity on a glass plate, slowly, when a confused crystalline crust will be obtained. On examining this crust with a common lens, it will be found to consist of numerous minute octohedral crystals, presenting triangular surfaces by reflected light. By this simple experiment, arsenic is distinguished from every other metallic poison. 1. On adding to the solution,—*ammonio-nitrate of silver*,—a rich yellow precipitate of arsenite of silver falls down :—rapidly changing in colour to a greenish brown. The test is made by adding to a very strong solution of nitrate of silver, a weak solution of ammonia, continuing to add the latter, until the brown oxide of silver, at first thrown down, is almost re-dissolved. The yellow precipitate is soluble in nitric, tartaric, citric and acetic acids, as well as in caustic ammonia. It is not dissolved by potash or soda. 2. On adding to the solution of arsenic *ammonio-sulphate of copper*, a rich green precipitate is formed, the tint of which varies, according to the proportion of arsenic present and the quantity of the test added. This test is made by adding ammonia to a solution of sulphate of copper, until the bluish white precipitate, at first produced, is nearly redissolved: it must not be used too highly concentrated, as it possesses a deep violet blue colour, which may render obscure, the green precipitate formed. The precipitated arsenite of copper is soluble in all acids, mineral and vegetable, and in ammonia, but not in potash or soda. When dried and collected, it possesses this valuable property :—by very slowly heating a few grains in a tube of small bore,—arsenious acid is slowly sublimed in a ring of minute resplendent octohedral crystals,—oxide of copper being left as a residue.

These are called the liquid tests for arsenic. The silver test, first discovered by Mr. Hume, in 1789, (Marshall on Arsenic, 87,) acts with remarkable delicacy, and is of great use as a corroborative test in the various processes for determining the presence of arsenic. A solution of an alkaline phosphate, which yields a yellow precipitate with nitrate of silver, is not affected by the ammonio-nitrate when properly made; and conversely, a solution of arsenious acid gives only a faint turbidness with nitrate of silver, while it is copiously precipitated of a yellow colour by the ammonio-nitrate. Medical jurists appear to have overlooked the fact, that a solution of phosphoric acid is precipitated by this test, exactly like a solution of arsenic: but the answer to any objection on this ground, is that phosphoric acid either gives no precipitate or one of a pale blue colour, with the ammonio-sulphate of copper,—that it is not affected by sulphuretted hydrogen gas, and lastly, that on boiling copper in the acid liquid, and adding muriatic acid, there is no deposit of arsenic on that metal. With respect to the delicate reaction of this test, Mr. Marshall states, (On Arsenic, p. 94, ed. 1817,) that it is fully capable of detecting the 1,000th part of a grain in solution,—a proof that the application of this test was well understood more than a quarter of a century ago. Dr. Traill has lately asserted that the 16,000th part of a grain of arsenic in solution, is precipitated by the silver test, and that with the 10,000th part of a grain the precipitate is visible to the eye. I have found that the 8,000th part of a grain dissolved in one drop of water gave a pale yellow film, but the result materially depended on the quantity of water present. Thus the 4,000th part of a grain of arsenic in ten drops of water, was not perceptibly affected by the test; but the 2,000th of a grain dissolved in four drops of water, gave a decidedly yellow precipitate. The evidence derivable from these minute reactions, would not be of much value, except that the test is used to confirm inferences from the results of other experiments. The sulphate of copper test is far less delicate in its reaction, and having an intensely blue colour, it entirely conceals the green tint which may be given by a small quantity of precipitated arsenite of copper. Thus I found in an experiment, by cautiously adding an arsenical solution of known strength to a few drops of the test, that no green tint appeared in the precipitate, until the quantity of arsenious acid amounted to the 173rd part of a grain in less than one fluid-drachm of water—the degree of dilution being about 8,640 times.

No one, in the present day, would think of employing these liquid tests in solutions, in which the arsenic was mixed with organic matter. Almost all liquids used as articles of food are precipitated or coloured by one or both of them, somewhat like a solution of arsenic, although none of that poison be present. Thus, then, any evidence founded on their employment, unless the arsenic be dissolved in pure water, or unless the precipitates yield the poison, should be rejected. On the whole, these liquid tests appear to me to be useful, rather as adjuncts to other processes than as a direct means of detecting arsenic. An exclusive reliance upon them has led to the rejection of chemical evidence on several trials, where they had been most improperly employed in the analysis of suspected liquids containing organic matter. The trial of Donnall at Launceston, in 1817, affords a memorable lesson to the medical jurist on this subject.

Sulphuretted hydrogen gas.—The hydro-sulphuret of ammonia gives no precipitate in a solution of arsenic until an acid has been added, whereby arsenic is known from most metallic poisons. On adding an acid (acetic) a rich golden yellow coloured precipitate is thrown down (orpiment or sesqui-sulphuret of arsenic.) It is better, however, to employ in medico-legal analysis, a current of sulphuretted hydrogen gas, which is easily procured by gently heating the sulphuret of iron in diluted sulphuric acid. The arsenical liquid should be slightly acidulated with acetic acid, before the gas is passed into it. The yellow compound is immediately produced if arsenic be present, and may be collected by boiling the liquid to drive off any surplus gas. The precipitation is likewise facilitated by adding to the liquid a solution of muriate of ammonia. This yellow precipitate is known to be sesquisulphuret of arsenic by the following properties:—1. It is insoluble in water and alcohol, as well as in all acids mineral (muriatic) and vegetable, but it is decomposed by strong nitric, and nitro-muriatic acids. 2. It is immediately dissolved by caustic potash, soda, or ammonia, forming a nearly colourless solution. 3. When dried and heated with soda-flux, it furnishes a metallic sublimate of arsenic. This last experiment requires a little care, as some sulphur is apt to be sublimed, and obscure the results. Unless these properties are proved to exist in the yellow precipitate formed by sulphuretted hydrogen in an unknown liquid, it cannot be a compound of arsenic; and it would not be safe to receive evidence on the point. On the other hand, when these properties are possessed by the precipitate, it must be arsenic, and can be no other substance.

This test is extremely delicate in its reaction. It begins to give a yellow tinge when the liquid contains only the 4,000th part of a grain of arsenious acid in ten drops of water, the arsenic therefore forming about the 10,000th part of the solution. This becomes more decided with the 2,000th part of a grain, and still more with the 250th part of a grain: the sesquisulphuret is not, however, precipitated until a solution of muriate of ammonia has been added to the liquid. It is important to observe that the effect produced by the test, will materially depend on the quantity of water in which the given weight of arsenic happens to be diffused. In one experiment the gas was passed into a solution containing the 400th part of a grain in twenty drops of water, the results were clear and decided; the liquid acquired a rich golden yellow colour, but when passed into a solution containing the same weight of arsenic in half an ounce of water, a yellow tint was scarcely perceptible. The arsenic in the first case was in the proportion of the 8,000th, and in the second of only the 1,000,000th part of the solution.

Objections to the gaseous test.—Many objections have been taken on criminal trials to the medical evidence, founded on an application of this most valuable test. 1. Cadmium. It is remarkable that this metal should furnish, at the same time, a plausible ground of objection, both to the process by reduction from the solid state, and to the gaseous test applied to a solution of the poison. Thus the soluble salts of cadmium yield, with sulphuretted hydrogen, a rich yellow precipitate resembling closely that produced by arsenic, and this also gives a metallic sublimate when heated with soda-flux.

There are, however, these striking differences;—the yellow compound of arsenic is soluble in ammonia, that of cadmium is insoluble,—the compound of arsenic is insoluble in strong muriatic acid, that of cadmium is perfectly soluble. Of the dried precipitates, the sulphuret of arsenic is not affected by strong muriatic acid, even on boiling,—that of cadmium is dissolved readily with the evolution of sulphuretted hydrogen gas; and a salt of cadmium is thereby formed, precipitable by alkaline carbonates. A solution of a salt of cadmium is immediately thrown down, of a rich yellow colour, by hydro-sulphuret of ammonia,—that of arsenic is not precipitated by this agent. There are many other differences; thus cadmium is not precipitated on copper like arsenic, when boiled with muriatic acid, and it does not combine with hydrogen to form a combustible gas. An objection on the ground of the strong similarity of cadmium to arsenic, was taken to the chemical evidence given on the trial of Mrs. Burdock at Bristol, in 1835; but it fell to the ground, from the very skilful manner in which the analysis had been conducted by Mr. Herapath. 2. Tin. A persalt of tin is precipitated of a dusky yellow by the gas; but the precipitate is destitute of all the properties of sulphuret of arsenic; it is insoluble in ammonia, and it gives no metallic sublimate when heated with flux. A solution of tin is also known from one of arsenic, by its being instantly precipitated by the hydrosulphuret of ammonia. 3. Antimony. A solution of this metal is precipitated of a rich orange red (not yellow) by the gas,—the precipitate yields no metallic sublimate with flux, and the solution of antimony is also precipitated by hydrosulphuret of ammonia.

An important medico-legal question has arisen in relation to the tests for arsenic, namely,—whether we can rely upon any tests for this poison, independently of its reduction to the metallic state. Is it absolutely necessary, chemically speaking, to obtain the metal in order to say that arsenic is certainly present in an unknown case? There is a popular prejudice in favour of this metallic reduction; and courts of law, as well as the public, are disposed to regard the obtaining of the metal, as the only conclusive proof of the presence of this poison. The acquittal of Donnall, at Launceston, in 1817, mainly took place from the circumstance that the medical witnesses could obtain no metallic arsenic:—they trusted to the liquid reagents alone, and these had unfortunately been applied to coloured fluids mixed with organic matter. At a trial on the Norfolk Spring Circuit, 1833,—the medical witness admitted that the metallic reduction would have been more satisfactory,—but he had consumed the fluids of the stomach in applying the liquid reagents. This evidence, although not absolutely rejected by the court, was not well received, and the prisoner was acquitted. This being a purely chemical question, must of course be answered on chemical principles, for it is chemical certainty that the law requires. If a white powder were presented for analysis, and it was found to possess distinctly the three first characters pointed out (p. 146)—could any chemist entertain a reasonable doubt that the powder was white arsenic?—I think not. The reduction process might corroborate, but I do not see how it could add *greater* certainty to the results thereby obtained; and in heating such a powder with flux, the chemist knows that a metallic sublimate must, of necessity, be formed; for there is no white solid in the whole range of substances known to chemistry, if we except arsenious acid, which possesses the three characters mentioned. If we are so situated that we are obliged to rely upon one test only, then the process by reduction should be preferred; but even here, so many mistakes have been made relative to the supposed metallic crust obtained from an unknown solid, that Dr. Turner and others have recommended that it should always be re-converted to arsenious acid in oxidating it by heat; and that the white solid thus produced should be tested by liquid re-agents. If arsenic in the form of a sublimate were presented to a chemist, and he were required to state its nature, he would necessarily treat it in this way, before expressing a judicial opinion;—because its real nature could only be with certainty established by such experiments. In a case in which the particulars are entirely unknown, there is nothing in the physical characters of an arsenical sublimate, to justify a witness in giving a positive opinion respecting it, before he has submitted it to various chemical processes.

It appears to me, that the action of sulphuretted hydrogen and the characters of the resulting sulphuret, coupled with the negative effect of hydrosulphuret of ammonia, as clearly indicate the presence of arsenic chemically speaking, as the obtaining of a metallic sublimate. Where the matter is at all doubtful, the sulphuret should be reduced; but, in such a case, if a sublimate be obtained by the reduction of the sulphuret, the precise nature of this should be verified by gently heating it in a wide reduction tube under a free access of air. In a case otherwise doubtful, we should always avoid relying upon *one* test only:—the reduction process is open to as great fallacies as the gaseous test; and if it be true that there is no other substance in chemistry which yields by reduction a metallic ring like that of arsenic, it is equally true that there is no substance in chemistry which yields with sulphuretted hydrogen gas a golden yellow precipitate, soluble in potash, soda and ammonia, and insoluble in muriatic acid. If a person be poisoned by potash, and the alkali is found in the stomach,—the medical witness can safely depose to that fact, without extracting the potassium; although there is no test applied to potash, which would be so unexceptionable, as the properties possessed by the metal potassium, if it could be readily extracted. But can it be said that chloride of platina and tartaric acid more strongly indicate the presence of potash, than sulphuretted hydrogen and the liquid tests do, that of arsenic? So in the case of barytes, it is not required as a point of chemical evidence that the metal barium should be reproduced; but—Are the liquid tests for barytes more conclusive than the gaseous and the liquid tests for arsenic? If we refer to the common metals themselves, we do not find that this doctrine of metallic reduction is invariably carried out; or the processes of toxicology would, with the exception of a very few cases, consist in simply incinerating the suspected substance with flux and charcoal. On the contrary, this latter process is only resorted to in extreme or doubtful instances; and the sufficiency of the liquid reagents for detecting metals, is made evident by the care bestowed on the description of them by all toxicological writers. In a case of poisoning by lead, tin, zinc, silver, or iron, the presence of each may be speedily demonstrated by the application of liquid tests; and yet these are not more free from fallacy, than those for arsenic. Admitting that practical toxicology was confined to the extracting of the pure metals alone, how could a prudent chemist be satisfied of the nature of certain minute discoloured particles of metal without dissolving them in an acid, and trying the solutions with liquid re-agents? It appears to me, then, that we may have a chemical certainty of the presence of arsenic, without the production of the metal being necessary; and this rule is either rightly applicable to arsenic, or it is most wrongly applied to other medico-legal cases. Dr. Christison justly considers, that the reduction process is not more conclusive in the opinion of a chemist, than the method by fluid tests; but he regards the former to be necessary, rather as a concession to the unscientific minds of a criminal court and jury (247). I fully agree with him that this principle should be kept in mind by every medical witness; but I cannot approve the doctrine, that any criminal court should be permitted to select its own degree of proof in a subject with which it must be entirely unacquainted. A scientific medical witness ought to be most freely trusted in this, as he is in other more abstruse parts of medical jurisprudence. It must be admitted, however, that since the very simple method of reduction by copper, introduced by Reinsch, this question has lost much of its interest. There is now no reason why a witness should neglect to procure arsenic in the metallic state; since the metal may be easily obtained from a quantity of this substance so small, as scarcely to be affected by the liquid tests.

MARSH'S TEST. HYDROGEN TEST.—The action of this test depends on the decomposition of arsenic, and its soluble compounds, by hydrogen evolved in the nascent state from the action of diluted sulphuric acid on zinc. The apparatus is of the most simple kind, and is so well known as to need no description. The arsenic may be introduced into the short leg of the tube, in the state of powder; but it is far better to dissolve it in water, by boiling, either with or without the addition of a few drops of caustic potash. The metallic arsenic combines with the hydrogen, forming arsenuretted hydrogen gas, which possesses the following properties. 1. It burns with a bluish white flame, and thick white smoke (arsenious acid). 2. A cold plate of glass held in the flame near the point receives a dark stain from the deposit of arsenic upon it. This stain is composed in the centre of pure metallic arsenic, which may be sometimes raised up in a distinctly bright leaf of metal,—immediately on the outside of this, is an opake black ring, (suboxide or hydruret of arsenic), which, when viewed by transmitted light, is of a clear hair-brown colour at the extreme edge :—if the quantity of arsenic be very small, the metallic lustre and opacity may be wanting, and the whole stain will have this colour by transmitted light. On the outside of this black ring, is a thin wide film of a milk-white appearance, which is nothing more than arsenious acid reproduced by combustion. 3. A white saucer moistened with ammonio-nitrate of silver, held about an inch above the flame, will be found, if arsenic be present, to be coloured yellow, from the reproduced arsenious acid in vapour being absorbed, and forming yellow arsenite of silver, easily soluble in acetic acid and ammonia. Unless the gas possess these properties, there is no certain evidence of the presence of arsenic in the liquid examined.

It has been recommended to act on the supposed arsenical deposit with diluted nitric acid, so as to convert the arsenic to arsenious acid, and then apply to the solution thus procured,—the silver and the gaseous tests. This plan will answer very well, when there is a thick deposit, or when several deposits have been purposely accumulated on one spot; but otherwise, the results are not satisfactory.

Marsh's test is undoubtedly one of great delicacy. MM. Danger and Flandin assert that metallic deposits may be procured when the arsenic forms only the 2,000,000th part of the liquid examined. (De l'Arsenic, 83.) M. Signoret states that he has procured metallic deposits with only the 200,000,000th part of arsenic in the liquid: this is in the proportion of one grain of arsenic dissolved in about 400,000 ounces, or 3000 gallons of water!

As the delicacy of this test has been already made a subject of discussion in a court of law (the Queen against Hunter, Liverpool Spring Assizes, 1843) it may be proper to offer a few remarks respecting it. It was stated on that trial, that the one millionth part of a grain of arsenic might be rendered visible by Marsh's test, and the judge, guided by this statement, put the question to another medical witness, whether arsenic could be so removed from the stomach in three days as that it would be impossible to discover the one millionth part of a grain in the body. It appears to me, the facts relative to the delicacy of tests, are not always stated with sufficient clearness on these occasions. Thus we ought to know two points,—1. The total quantity of poison experimented on; and 2. The degree of dilution, or the total quantity of liquid in which the poison was dissolved or suspended. There is no doubt that considerably less than the millionth part of a grain of arsenic may by Marsh's test, be rendered visible on a glass-plate: it is possible to distinguish with the eye a piece of leaf gold which would weigh less than the ten millionth part of a grain; but the real question is,—whether the test will discover arsenic in a single drop of solution, made by dissolving one grain of the poison in a million grains or sixteen gallons of water. If not, the statement amounts to nothing; for it is clear that if more than one drop of such an extremely diluted solution be taken, the test is acting upon a larger quantity of arsenic than the above form of expression would indicate. I have generally found that the fractional quantity stated to be detected, referred rather to the degree of dilution, than to the absolute quantity of poison present: whereas a test may fail to act, as we have already seen, either from the smallness of the quantity of poison present, or from the very large quantity of water in which it is diffused. The results of my own experiments are, that where the arsenic is mixed with the acid liquid in a tube capable of holding two fluid ounces, very faint and scarcely perceptible deposits begin to be formed on a glass plate with a quantity equal to the 2160th of a grain: the diffusion here being equal to two million times the weight of the poison. With the 1080th of a grain in the same quantity of water, the arsenic forming therefore one millionth part, slight brown annular stains were procured. With the 720th of a grain, the arsenic being in the proportion of about the 800,000th of the liquid,—the stains were much more decided, but quite imponderable. With the 100th grain in one fluid ounce of water (the 48,000th part) and the 67th grain in two fluid ounces (the 64,800th part) the deposits on glass were decided and characteristic; and it is at this point, that the tests begin to be safely available for the purposes of legal medicine. The delicacy of Marsh's test has no doubt been sometimes improperly estimated by the assumed weight of the metallic deposit on glass; whereas it is probable that the quantity of arsenic in one such infinitesimal deposit, if transferred to the apparatus, would give no indication whatever of its presence. In these experiments it must be remembered that we are operating on the whole quantity of the poison, dividing and subdividing the metal into a series of deposits, the weight of some of which might not be equal to the millionth part of the weight of the arsenic which is actually furnishing them.

Objections to Marsh's test.—Other substances will combine with nascent hydrogen, and when that gas is burnt, a deposit will be formed on glass which may be mistaken for arsenic. Late researches have shown, that a liquid containing antimony, tellurium, selenium, iodine, bromine, phosphorus and sulphur, or some kinds of organic matter, may in this way produce an inflammable gas, and leave a deposit on glass. The only objection of any practical force is that founded on the presence of antimony. There are these differences between the arsenical and antimonial stains; the stain of antimony has not the bright metallic lustre which that of arsenic sometimes presents; by transmitted light it is of a smoky black, while that of arsenic is of a hair-brown colour. Although the antimonial, burns like the arsenical flame, yet the third property is entirely wanting. If the ammonio-nitrate of silver be held over the antimonial flame, the silver is reduced; no yellow arsenite is formed, as in the case of arsenic. This last criterion distinguishes the arsenical flame from that produced by all the other bodies above-mentioned. It has been said that phosphorus, burnt under the form of phosphuretted hydrogen, would produce the same effect, but this objection appears to be purely speculative. No fallacy is likely to arise on this ground; for it is difficult to conceive how any person at all acquainted with chemistry, could ever mistake a phosphuret for arsenious acid or an arsenite. There is another difference which I do not remember to have seen pointed out, namely, that if the deposits be received on a sheet of bright copper or brass, *that* from arsenic has an iron-grey lustre and clear metallic polish; that from antimony presents the same rings of black hydruret of antimony alternating with rings of oxide which are observed on glass. I have not found any metallic lustre from antimony under these circumstances, and the antimonial deposit is removed by the slightest friction, while that from arsenic is persistent. The effect of the flame of pure hydrogen on metallic copper is merely the production of certain iridescent rings of oxide; no iron-grey colour is given to the copper unless arsenic be present. Further, the arsenical stain is soluble in chloride of soda, (Bischoff,) and after boiling with muriatic acid, the arsenic may be precipitated from it in the state of sulphuret by sulphuretted hydrogen gas. The antimonial stains, on the other hand, are insoluble in the chloride of soda.

But, secondly, the sublimate may be proved to be arsenical, and yet it may be fairly alleged that the arsenic was derived from other sources, and not from the suspected liquid. Zinc and sulphuric acid, which are employed in the experiment, are often impure. Dr. Clark, of Aberdeen, informs me that he has not discovered a specimen of zinc free from arsenic, when about an ounce of the metal was used in an experiment, and the arseniuretted hydrogen was tested by a solution of nitrate of silver. Sulphuric acid has been found to contain either arsenic or selenium;—the latter substance yields a brown deposit; but in every other respect it differs from arsenic. The zinc and sulphuric acid which I have been in the habit of using, have not, in the quantities employed in these experiments, yielded any trace of arsenic, either by Marsh's test or by the copper test of Reinsch, to be presently spoken of. As this last mentioned test will certainly enable us to discover in a few minutes, the 4,000th part of a grain of arsenic, it may be fairly inferred, that where the results are negative, the arsenic in the zinc, if any be present, can form no obtion to the application of the test. The best answer to all objections of this kind is, that the materials should be tried repeatedly, before the suspected liquid is introduced into the apparatus. If no sublimate be formed until after the introduction of the suspected liquid, it is evident that the arsenic must be in the liquid introduced; a fact which may be considered as clearly established, if, on removing the liquid and washing out the tube, no stains whatever result from employing portions of the same sulphuric acid and zinc. If infinitesimal traces of arsenic be really present in the materials employed, they are obviously under these circumstances, not to be detected by Marsh's apparatus, and can present no practical objection to its use, unless we adopt the most improbable notion that the impurities are brought out in the materials through the action of the test by a mere coincidence at the time of the addition of the suspected poisonous liquids. In using this test, fresh zinc should be employed for each experiment; and the apparatus should be thoroughly cleansed before use. Dr. Geoghehan has found that arsenic is liable to be deposited on zinc by standing, probably from a partial decomposition of the arsenuretted hydrogen gas; and I have observed that the same deposit is apt to take place in the fine tube connected with the stop-cock.

These are, I believe, the only tangible objections to the use of Marsh's test, and they are not difficult of removal, where moderate care is taken. It will be apparent, that not one of these objections could apply, except to those cases where Marsh's test is relied on, as the sole and exclusive chemical proof of the presence of arsenic; but in most instances where this test is safely applicable, other tests are also applicable: and it does not at all diminish the merit of this most useful and ingenious discovery, to say that the results which it furnishes should be corroborated by the use of some of the other tests, if it were only for the sake of preventing any plausible objections to the inference derivable from its use. The great object of chemical evidence is not to show a court of law what may be done by the use of one test only, but to render the proof of the presence of poison most clear and convincing. If, in any case, we have no other proof to offer, but that furnished by Marsh's test, a case in which the quantity of poison must be infinitesimal, and the metallic deposits proportionably minute,—then it would be better to abandon the evidence altogether, than to maintain that poison is present from a result which admits of no sort of corroboration; for all who have experimented on the subject, must perceive the utter inefficacy of applying liquid tests to determine the chemical properties of imponderable and scarcely visible sublimates. It was owing to too great a confidence in the extreme application of this test, that arsenic was pronounced to be a natural constituent of the human body, existing especially in the bones and also probably in the muscular system; owing to the same cause, it was said to have been found in the loose soil of cemeteries, and rules were given to distinguish normal arsenic from that taken as a poison. The experiments of many English chemists, as well as those lately performed before the Academy in France by M. Orfila himself, have shown that arsenic does not naturally exist in the body; and that there must have been some undiscovered fallacy in his previous experiments. (Rapport de l'Academie Royale de Médecine, Juillet, 1841.)

Many modifications of Marsh's test have been proposed. Thus MM. Danger and Flandin burn the gas in connexion with a cooled receiver, so that a solution of arsenic is thereby obtained. They make it the medium of extracting arsenic in a state fitted for testing. M. Lassaigne and Dr. Clark cause the arsenuretted hydrogen to pass into a solution of nitrate of silver, whereby arsenious acid (Lassaigne) is obtained in solution, and arsenuret of silver is precipitated (Dr. Clark). Berzelius, Liebig, and Köppelin and Kampmann, conduct the arsenuretted hydrogen through a tube instead of burning it; and the two latter chemists dry the gas by making it pass over fused chloride of calcium. The tube is then heated, and a clear ring of metallic arsenic becomes deposited at a little distance from the point to which the heat is applied. This result depends on the fact that arsenuretted hydrogen is easily decomposed and its arsenic separated at a moderate heat. All other metals which combine with hydrogen are deposited in the spot which is heated; and do not, like arsenic, form a well-defined ring in front of it. Another modification has been suggested by Mr. Morton, namely, that of producing the hydrogen by the galvanic decomposition of water, instead of by the action of sulphuric acid and water on zinc. In this way it is expected that we should get rid of all the objections to the presence of arsenic or other impurities in the materials employed. The hydrogen evolved in such a case would be absolutely pure.

Reinsch's test.—Reinsch has lately discovered a very simple method of determining the presence of arsenic in liquids. We should add to the suspected solution a few drops of pure muriatic acid, and place in it a slip of bright copper. There is no change until the liquid is brought to the boiling point, when if arsenic be present even in small quantity, the copper acquires an iron-grey coating from the deposit of that metal. This is apt to scale off, if the arsenic be in large quantity. We remove the slip of copper, wash it in water, dry it and gradually heat it in a reduction tube, when arsenious acid will be sublimed in minute octohedral crystals: if these should not be apparent from one piece of copper, several may be successively introduced. This test succeeds perfectly with powdered arsenic, the arsenites, arsenic acid, the arseniates and orpiment. It will even separate the arsenic from the arsenite of copper and from common lead-shot. When the quantity of arsenic is small, the copper acquires a faint violet or blue coat, and the deposit is materially affected by the quantity of water present, or, in other words, the degree of dilution. But one great advantage is, that we are not obliged to dilute the liquid in the experiment, and there is no loss of arsenic except as it may be removed by the introduction of successive portions of copper. This test failed to detect the 4,000th part of a grain of arsenic in thirty drops of water, the dilution being equal to 120,000 times the weight of the arsenic. The deposit on copper commenced with a violet coloured film, when the quantity of arsenious acid was equal to the 3,000th part of a grain in thirty drops of water, or under a dilution of 90,000 times its weight. It was also very decided with the 2,000th part of a grain in the same quantity of water, but in neither of these cases could octohedral crystals of arsenious acid be obtained by heating the copper. The following experiments will show how this test is liable to be affected by dilution ;- the copper was coated in a few seconds, when boiled in a solution containing the 4,000th part of a grain in ten drops of water, although the test had failed to detect the same weight of arsenic in three times that quantity of water. So again, the 2,160th part of a grain in thirty drops of water gave an arsenical deposit on copper; while the same weight in half an ounce of water did not produce any effect on the metal.

Certain objections may be urged to this test. Thus it may be said, that arsenic was present in the muriatic acid : this is at once answered by boiling the copper in a portion of the muriatic acid before adding the suspected liquid. A more important objection is, that other metals are liable to be deposited on copper under similar circumstances. Thus this is the case with antimony, whether in the state of chloride or of tartar emetic ; nor is it always possible to distinguish by the appearance, the antimonial from the arsenical deposit. Should the quantity of antimony be small, the deposit is of a violet tint; if large, of an iron grey colour exactly like arsenic. Tin and lead become tarnished under the same circumstances, but there is no decided metallic deposit. Bismuth produces a deposit very closely resembling that of arsenic. With respect to mercury and silver, a metallic deposit takes place in each case without boiling. In a salt of nickel or cadmium, the copper undergoes no change; hence this is another important distinction between cadmium and arsenic. Lastly, if an alkaline sulphuret, or sulphuretted hydrogen be present in the liquid, the surface of the copper will become tarnished; but this effect takes place on contact without boiling, and without rendering the addition of muriatic acid, necessary.

There is one answer to all of these objections, namely, that from the arsenical deposit, octohedral crystals of arsenious acid may be procured by *slowly* heating the slip of copper in a reduction tube. If while heat is applied to the copper, in a long piece of tube drawn out at one end, a current of air be gently blown through it, a ring of white arsenious acid will be obtained; this may be filed off, boiled in water and tested by the ammonio-nitrate of silver and sulphuretted hydrogen.

Of all the methods of detecting arsenic, there is none so simple or so easy of execution as this; and it is probable that in a short time, it will supersede most of the other more complex processes of testing for this poison.

GALVANIC TEST.—If a small quantity of arsenic in solution, acidulated with muriatic acid, be placed in a platina capsule, and a piece of zinc foil introduced, a galvanic action ensues, by which metallic arsenic is deposited on the platina in a thin film. The capsule may be washed, dried, and heated. A plate of glass placed over it, will collect the arsenious acid, into which the metallic arsenic is converted by sublimation. I have found in this experiment, that the arsenic is deposited as much on the zinc as on the platina, and there is a great loss of arsenic from the production of arsenuretted hydrogen. On the whole, this is by no means an advisable mode of testing; and it is at the same time far inferior in delicacy to Marsh's test and Reinsch's test. So much arsenic is occasionally deposited on the zinc, that by heating it slowly in a reduction-tube, I have procured from it octohedral crystals of arsenious acid.

In liquids containing organic matter.—Arsenious acid, when in a state of solution, is not liable to be precipitated by any animal or vegetable principles, although all such substances render it less soluble in water. The liquid for analysis should be filtered through muslin, cotton, or paper, in order to separate any insoluble matters. Should it be coloured, this is of little moment, provided it be clear. If viscid, it should be diluted with water and boiled with a small quantity of muriatic acid; on standing, a deposit may take place, and this should be separated by a filter. As a trial test, we may now boil in a portion of the liquid, strongly acidulated with pure muriatic acid, a slip of bright copper. In a few seconds, if arsenic be present, this will acquire a grey metallic coating. If the copper remain unchanged, the arsenic, if present, must be in extremely minute proportion; if, on the other hand, the copper be covered by a grey deposit, it should be dried and heated in a reduction tube in the way already described (Reinsch's test,) in order to obtain from it, octohedral crystals of arsenious acid. From several such slips of copper, a quantity of metallic arsenic may be procured, sufficient, on reconversion to arsenious acid, to allow of a solution in water being made, to which all the liquid tests may be applied. In this way, the 144th part of a grain of arsenious acid was detected in two fluid drachms of gruel, milk, porter, and other organic liquids, in so many different experiments. It has also been thus easily separated from wine, brandy and the liquid contents of the stomach of a person poisoned by arsenic. Here our analysis might be closed, if the object were to determine only the presence of arsenic, since a case can rarely occur in medico-legal practice, where it would be necessary to extract the whole of the arsenic from the fluid contents of the stomach.

The process hitherto pursued for procuring evidence of the presence of this poison in liquids, has consisted in transforming the arsenious acid to the state of sesquisulphuret, and decomposing this compound by an alkaline flux. As a trial test, we may first dip a piece of white filtering paper into the suspected liquid, and expose it to the action of a current of sulphuretted hydrogen gas in a tube. If arsenic be present, the paper will acquire a rich yellow colour, which immediately disappears on dipping it into a solution of ammonia. If the quantity of arsenic thus taken up by the paper, be less than the 4000th part of a grain, there will be no change of colour. We then test about half an ounce or an ounce of the liquid by passing the gas into it. Having satisfied ourselves that arsenic is present, we may get rid of a portion of the organic matter, by boiling the liquid with acetic acid and filtering. This object may be further accomplished by adding to the liquid when cold, one-third of its bulk of alcohol, again filtering and separating the alcohol by distillation. Sulphuretted hydrogen gas may now be freely passed into the liquid, acidulated with acetic acid. When all further precipitation ceases, the liquid should be filtered, the precipitate collected, dissolved in ammonia, and reprecipitated hy an acid. By digesting it in water, alcohol, and muriatic acid successively, it may be deprived of any organic matter combined with it, sufficiently to allow of its reduction by soda-flux in the way described. The sulphuret has sometimes a dark brown colour from adhering organic matter, it is then better to transform it to arsenic acid by boiling it in nitromuriatic acid,—during which process, the organic matter is entirely destroyed, and a solution of arsenic acid is obtained and rendered fitted for testing, by digesting the evaporated residue in distilled water; or the sulphuret may be deflagrated with nitre, and arseniate of potash then obtained. In this case the surplus nitric acid should be driven off by sulphuric acid. An abundant deposit of metallic arsenic is procured by boiling the liquid, in either case, with muriatic acid and copper. In this way it is easy to analyse wine, coffee, tea, milk, porter, brandy aud similar liquids, for arsenic. Fowler's mineral solution containing the arsenite of potash, may be thus examined ; but in this case it would be hetter to resort at once to Reinsch's test. If the liquid for analysis should contain oil, this may be separated after boiling, by passing it through a wet filter.

Other modifications of the process might be suggested, but perhaps it will be better to give the result of a direct analysis. Two grains of arsenic were dissolved in half a pint of coffee. The liquid was rendered slightly alkaline by potash, in order to dissolve the arsenious acid, evaporated, and the residue strongly heated. This residue was then digested in alcohol to dissolve out any arsenite of potash present, and a solution of a pale straw colour, amounting to about two drachms, was obtained. This was strongly acidulated with acetic acid, and again filtered. A current of sulphuretted hydrogen gas was passed into one half, and a yellow sulphuret soluble in ammonia was readily obtained, although sulphuretted hydrogen failed to detect the poison in the original coffee. The other half of the solution (one drachm) yielded also very satisfactory results with Marsh's test.

The *contents of the stomach* often contain lumps of arsenic which may be separated by throwing those portions that do not pass through a filter into a large glass of distilled water, and after giving to it a circular motion, suddenly pouring off the supernatant liquid, when the heavy portions containing arsenic will be found at the bottom. The lumps may sometimes be felt in the contents: they may then be easily removed, dried on filtering paper, and tested. If the arsenic has been taken in fine powder, there will be no lumps, but it will probably be deposited in masses, mixed with mucus, on the coats of the organ in those parts where the organ is much inflamed and ulcerated. The arsenic in this state looks like moistened plaster of Paris, but is of a darker colour. It may be removed on a spatula, spread in masses on filtering paper, and slowly dried. As it dries, the granules will detach themselves from the mass, and then may be easily tested by the reduction process,—by Reinsch's test, as well as by the ammonio-sulphate of copper. On gently heating a quantity of the precipitated arsenite of copper, crystallized arsenious acid may be obtained. In this way we avoid the troublesome and complex method of separating arsenic from organic liquids. The fact that the liquid contents yield no arsenic, must not lead us to suppose that the poison is absent. I have found solid arsenic spread over the coats of the stomach in two cases, when the liquid contents yielded no traces of the poison in solution. If none should be found either dissolved in the contents, or on the surface of the organ, we must cut off the inflamed and ulcerated portions of the mucous coat, and boil them in water rendered alkaline by a few drops of potash, for half an hour. The liquid may be then filtered and tested. It often happens that no arsenic is detected in the contents of the stomach or vomited matters, until after they have been boiled for one or two hours. It is advisable in such cases to render the liquid slightly alkaline by potash, in order to favour the solubility of the poison.

The value of the chemical evidence does not depend on the discovery of any particular quantity of poison in the stomach,—it is only necessary that the evidence of its presence, should be clear and satisfactory. In the case of Margaret Wishart, Dr. Christison did not detect more than one-fortieth of a grain of arsenic in the coats of the stomach ; but this was deemed sufficient chemical evidence, and the prisoner was condemned and executed. (Ed. M. & S. J. xxix. 23.)

It is an important medico-legal fact, that in many undoubted instances of arsenical poisoning, not a trace of the poison can be found in the stomach or its contents. Several of these cases have occurred to my knowledge. In one, a girl took an ounce of the poison, and died in seventeen hours: there was much vomiting and purging, and the stomach pump was used,—facts that might sufficiently account for the non-detection of poison in the body. In a second, nearly two ounces of arsenic were swallowed, and the person died in eight hours. No arsenic was discovered in the stomach. Even where there has been no vomiting and purging, the poison is not always found, but then the dose is generally small. Thus in the case referred to me by Mr. Veasey, no arsenic could be detected in the stomach, duodenum, or their contents, although the patient had neither vomiting nor purging. Reasons have been already assigned for the non-discovery of the poison. (See ante, p. 65.)

In order to provide a remedy for this difficulty, and to furnish chemical evidence where it must otherwise fail, Orfila and others have proposed methods for extracting the arsenic absorbed, from the blood, secretions and viscera of the deceased. Orfila simply dries the animal matter and adopts the old process of incineration with nitre,—sulphuric acid is afterwards added to the lixivium, and the sulphate of potash produced is separated by crystallisation from the more soluble arseniate of that alkali, which is one of the products of incineration if arsenic be present in the animal matter. The arseniate formed may be then analysed by Marsh's apparatus, but it would also be advisable to employ Reinsch's test. In this way Orfila has detected arsenic in the blood, urine and all the soft organs of the body ; but it appears that he was never able to discover the poison in less than eight ounces of blood and a larger proportion of muscular fibre ; and he speaks of the occasional necessity of drying and incinerating the whole body. I have examined in this way four ounces of blood taken from one subject by two processes ;—and the whole of the duodenum and part of the ileum of another,—both of whom had perished under the acute form of arsenical poisoning, but without any successful result.

MM. Danger and Flandin carbonize the animal matter by boiling it to dryness in a small quantity of strong sulphuric acid, about one-seventh part by weight. They digest the resulting carbonaceous ash in nitro-muriatic acid, and after driving off the acid by heat, treat the residue with distilled water. This yields arsenic acid, if arsenic were present in the viscera, a compound easily discovered by Marsh's or Reinsch's test. In pursuing this process, I obtained from seven ounces of the liver of a man poisoned by arsenic, about a dozen minute sublimates, as well as the action of the vapour of the flame on ammonio-nitrate of silver. It is highly probable, that before long, these processes will be materially improved and simplified. A full account of them will be found in the Traité de l'Arsenic of MM. Danger and Flandin.

Although the results thus obtained are open to many objections, yet one or other of the processes should be tried in all doubtful cases, where arsenic cannot be discovered in the body in the usual way. In the case of the Queen *v.* Hunter, tried at the Liverpool Spring Assizes, 1843, arsenic could not be detected in the contents of the viscera; and the judge suggested that the muscles of the deceased should have been examined. There is no doubt that evidence of this kind, when carefully obtained, will be received by a court of law. In the case of the Queen *v.* Thomas, tried at the Cardiff Summer Assizes, 1843, Mr. Herapath deposed that he could find no arsenic in the contents of the stomach and intestines of one of the deceased; but he readily detected the poison in the liver by incineration with nitre. This evidence, although attacked in cross-examination on the ground (now refuted) that arsenic was a natural constituent of the body, was received as satisfactory evidence of the presence of the poison. The prisoners were acquitted, apparently from the want of proof of administration. This case shows that the detection of the absorbed arsenic must henceforth form a part of the duty of a medical jurist, where his other chemical experiments fail in discovering the poison.

When the poison is really present in the stomach at the time of death, it does not easily disappear, and may therefore be discovered for a long time after interment. In Mrs. Smith's case, the sulphuret of arsenic was discovered in the stomach fourteen months after interment;—in another case, it has been detected at the end of three years, and in a third after seven years interment, (Med. Chir. Rev., April 1835;) but this I believe is the longest period. I have ascertained that when the contents of the stomach are not allowed to drain away, the arsenic may be easily detected after a very considerable period. A person died from the effects of arsenic on the 21st of February, 1834,—the poison was at the time easily found in the contents of the stomach; they have now been kept for upwards of nine years loosely covered, and arsenic is still as readily to be detected in them as in the first instance, whether Marsh's or Reinsch's test, or sulphuretted hydrogen be employed.

Arsenic in solids.—Arsenic may exist in solid articles of food, such as bread;—it is also improperly introduced into the manufacture of some kinds of candles which may require analysis; and the matters vomited by a person poisoned may sometimes be imbibed by articles of clothing or furniture. In all these cases, we should simply boil the solid in water, with the addition of copper and muriatic acid, or to separate the whole of the poison we may proceed, as in the case of organic liquids, by using a current of sulphuretted hydrogen gas. A cat was poisoned with half a drachm of arsenic,—the animal died in about nine hours. No trace of poison was found in the body; but a small part of the floor of the room where the cat had vomited, was scraped off, boiled in water, and yielded on analysis, clear evidence of the presence of the poison.

QUANTITATIVE ANALYSIS.—The whole of the arsenic from a measured portion of liquid must be precipitated by sulphuretted hydrogen, as sesquisulphuret. This should be purified by dissolving it in ammonia: it may be then washed, dried, and weighed. Every hundred grains of sesquisulphuret obtained, indicate about eighty grains of white arsenic. Should the sesquisulphuret be very impure, it may be converted to arsenic acid, and the proportion calculated by precipitating this, as arseniate of silver.

ARSENIC ACID.—This is an artificial product confined to the chemical laboratory. It is a powerful poison, but I have never heard of an instance in which it has destroyed life.

CHEMICAL ANALYSIS.—It is a white uncrystalline deliquescent solid. 1. It is not volatilized on platina foil, by the flame of a lamp. 2. It is very soluble in water, forming a highly acid solution. 3. It is precipitated of a dull red colour by nitrate or the ammonio-nitrate of silver. In all these characters it differs from arsenious acid. 4. It yields readily an arsenical sublimate with charcoal. 5. It yields abundant metallic deposits with copper and muriatic acid, or in Marsh's apparatus. It is precipitated, though slowly and of a pale yellow colour, by sulphuretted hydrogen gas. In these properties it resembles arsenious acid. The arseniates are poisonous. They possess the same chemical characters as arsenic acid.

Sulphuret of arsenic.—There are two kinds met with in commerce, orpiment or yellow arsenic, and realgar or red arsenic. They are very poisonous in consequence of their containing a large proportion of free arsenious acid. They are rarely used as poisons. Orpiment has, however, given occasion to two or three criminal trials in England.

Chemical analysis.—The powdered sulphurets yield a solution of arsenious acid on boiling them in water acidulated with muriatic acid. They readily give the well-known sublimates of metallic arsenic. both with soda-flux and in the hydrogen apparatus. They also yield readily a deposit of arsenic when boiled with copper and muriatic acid. Orpiment is insoluble in muriatic acid, but is easily dissolved by caustic potash.

Arsenuretted hydrogen.—This is a gaseous poison of arsenic, producing, when respired in small quantity, very serious effects upon the system. It has already occasioned death in three instances. This gas is an artificial product, and is formed in a chemical laboratory in various ways,—one method has already been described in speaking of Marsh's test, and its poisonous properties render it necessary that caution should be used in the employment of that mode of testing. The gas is most effectually decomposed, and prevented from diffusing itself by passing it into a solution of nitrate of silver. This form of gaseous arsenical poisoning has been hitherto purely accidental. Gehlen, a German chemist, was killed by accidentally breathing a small quantity : he was seized, an hour after respiring the gas, with vomiting, shivering and great prostration of strength. He died on the ninth day. The most complete history of this kind of poisoning has been published by Dr. O'Reilly of Dublin. He has been kind enough to forward me the particulars of one case.

A gentleman, for the sake of experiment, wished to respire about one hundred and fifty cubic inches of hydrogen gas. It unfortunately happened that the sulphuric acid, which he used for making the hydrogen, was largely contaminated with arsenic and immediately after respiring the gas, he was seized with giddiness and fainting, constant vomiting of a greenish coloured matter, and dull pain in the epigastrium. There was also complete suppression of urine. He died in about six days. On dissection, the liver and kidneys were found of a deep indigo colour,—the mucous membrane of the stomach was easily separated ; and there were two distinct patches of inflammation in the greater curvature. There was a quantity of reddish coloured fluid effused in the chest, and it is an interesting fact that Dr. O'Reilly, on examining about ten ounces of this fluid, was enabled to detect in it arsenic by the use of Marsh's test. From experiments made on the sulphuric acid, it is supposed that the deceased must have inhaled a quantity of arsenic equivalent to about twelve grains of arsenious acid.

The third case occurred in England, in December 1836. A young gentleman was killed by respiring the gas, evolved from a mixture of arsenic, zinc and sulphuric acid. Death did not take place until twenty-four days after the accident. It appears that in this instance but a very small portion could have entered into the lungs.

CHAPTER XVIII.

ON POISONING BY MERCURY AND ITS COMPOUNDS.

Metallic mercury, in the state of vapour, is well known to be pernicious to health, producing paralysis and other disorders of the system; but this is a form of poisoning which does not require medico-legal investigation. Liquid mercury appears to be entirely destitute of poisonous properties. Among numerous cases that are reported of this substance having been swallowed with impunity, may be mentioned one which was the subject of a report to the Westminster Medical Society in November, 1842. The individual in this case laboured under obstinate constipation which ended fatally. Five days before death, half a pound of fluid mercury had been swallowed as a remedial agent; no ill effects followed. On an inspection of the body, the mercury had wholly disappeared.

The most important mercurial poison is corrosive sublimate; but there are some other preparations of the metal, as calomel, the nitric oxide, and the acid nitrates of mercury, which have occasioned death.

Corrosive sublimate. (Bichloride of mercury.)—This substance is not often taken as a poison. In the coroner's report for 1837-8, there were about fifteen cases of mercurial poisoning, in twelve of which corrosive sublimate was the poison taken. This poison is commonly seen under the form of very heavy crystalline masses, or of a white powder. Its taste is powerfully austere and metallic, so that no poisonous quantity of it can be easily swallowed without the individual becoming immediately aware of it. It is very soluble in water, in which respect it differs strikingly from arsenic. Twenty parts of cold water (60^0) and two parts of boiling water (212^0) will dissolve one part of the poison. It is also readily dissolved by alcohol and ether; the last body takes up one-third of its weight, and has the property of abstracting it from its aqueous solution,—a principle which has been advantageously resorted to in separating the poison from organic liquids. It is soluble without change in nitric and muriatic acids, and it is a fact of some medico-legal importance, that common salt renders it much more soluble in water.

Corrosive sublimate, as its name implies, is a corrosive poison; it corrodes and chemically combines with the animal tissues; if it be much diluted with water, these corrosive properties are in great part destroyed; but it may under these circumstances act as a powerful irritant.

Symptoms. — The symptoms produced by corrosive sublimate, generally come on immediately or within a few minutes after the poison has been swallowed. In the first place, there is perceived a strong metallic taste in the mouth, often described as a coppery taste, and there is, during the act of swallowing, a sense of constriction and burning heat in the throat. In a few minutes violent pain is felt in the abdomen, especially in the region of the stomach, which is increased by pressure. Pain in the abdomen is, however, sometimes wholly absent. There is nausea, with frequent vomiting of long stringy masses of white mucus, mixed with blood; and this is accompanied by profuse diarrhea. The countenance is sometimes swollen and flushed, in other cases it has been pale and anxious. The pulse is small, frequent and irregular, becoming scarcely perceptible as the symptoms become aggravated. The tongue is white and shrivelled,—the skin cold and clammy, the respiration difficult; and death is commonly preceded by syncope, convulsions, or general insensibility. Suppression of urine has also been noticed among the symptoms. This symptom was observed lately in a well-marked case of poisoning by this substance at Guy's Hospital. The patient lived four days, but did not pass any urine during the whole of that time.

This poison differs from arsenic: 1, in having a well-marked taste; 2, in producing violent symptoms within a few minutes; and 3, in the fact of the evacuations being more frequently mixed with blood. The symptoms produced by corrosive sublimate, in the first instance, resemble those of cholera; if the individual should survive several days, they are more like those of dysentery,—tenesmus and mucous discharges mixed with blood being very frequently observed.

Mercurial preparations are well known to have a peculiar effect on the salivary glands, increasing the flow of saliva; but salivation is rather an uncertain and by no means a necessary symptom in cases of acute poisoning by corrosive sublimate. In many instances, the patient dies too rapidly for this effect to follow, but even where he survives some days, salivation is not always observed. In a case related by Dr. Venables, where two drachms of the poison had been taken, and the woman survived eight days, this symptom did not exist. But another, reported by Mr. Wood, (Ed. Med. and Sur. Jour. li. 114,) where half a tea-spoonful of the poison was taken, salivation was profuse in the course of a few hours; also, in a case which occurred at Guy's Hospital, in February 1843, where two drachms had been taken, salivation commenced in four hours. In the chronic form of poisoning, where the dose has been small and frequently repeated, we may expect to meet with this symptom, with fœtor of the breath and sponginess and ulceration of the gums. Should the person survive some time, salivation is more commonly met with than not; but in looking for it as an indication of mercurial poisoning, a medical jurist must remember, that some persons are wholly insusceptible of salivation. On the other hand, there are cases in which the salivary glands are most easily excited, so that the usual innocent doses of mercurial medicines, have been known to produce salivation to such a degree, as to cause death. Facts of this kind are of some importance, since charges of malapraxis may be easily raised in respect to them. Dr. Christison mentions a case in which two grains of calomel destroyed life by the severe salivation induced, as well as by ulceration of the throat. Another case was mentioned to me by a pupil, in 1839, in which five grains of calomel killed an adult by producing fatal salivation. From some cases related by Mr. Samuel of Newark, it appears that two grains of calomel divided into three powders, were given in the proportion of one powder daily, (two-thirds of a grain,) to a little boy aged eight. This small dose produced the most violent salivation, sloughing and exfoliation, from which he was some weeks in recovering. In another instance, a little girl aged five, took daily for three days, three grains of mercury and chalk powder. Her mouth was severely affected, sloughing ensued, and she died in eight days. In a third case, three grains of blue pill given twice a day for three days, making eighteen grains, were ordered for a girl aged nineteen, who complained of a slight pain in her abdomen. Severe salivation supervened, the teeth separated, and she died in twelve days. With respect to the effect of corrosive sublimate, Dr. Christison states that three grains of this substance in three doses, caused violent salivation. (366.) When this state results from the use of mild mercurial medicines in small doses, we must refer the effects to idiosyncrasy (antè. p. 21.) A person may die under these circumstances :—either from simple exhaustion or from extensive sloughing of the fauces with exfoliation of the bones. When an individual has recovered from the first effects of acute poisoning by corrosive sublimate, he may die at almost any period from these secondary consequences.

It is generally admitted by toxicologists, that salivation may be intermittent, i. e. that it may cease and reappear without more mercurial poison, or any mercurial preparation being given in the interim, although such cases are rare. As a matter of medical jurisprudence, this important question was brought to an issue at the trial of Butterfield, at Croydon, in 1775. The deceased was supposed to have been killed by the administration of small doses of corrosive sublimate ; and the fact of his having become salivated at or about the time of the alleged administration, was regarded as a proof of poisoning. In the defence, it was urged that the deceased had been salivated two months previously, under a common mercurial course, — that although the salivation had ceased for that period, it was probable that this was nothing more than a recurrence of the former :—it did not prove that there had been any fresh administration of mercury in the interim. There was a difference of opinion on this point among the witnesses, as there probably would be in the present day, if each relied upon his own individual experience. However, one of the witnesses had known salivation to recur without a fresh exhibition of mercury after the long interval of three months, and the prisoner was acquitted. Cases are reported of salivation recurring even after longer intervals than this.

Salivation is a symptom, not necessarily connected with the exhibition of mercury, and therefore taken alone, can never furnish evidence of mercurial poisoning. It may come on spontaneously from disease in the salivary organs. It may also be produced by many other substances besides the preparations of mercury. Thus it has been known to follow the use of the preparations of gold, copper, bismuth, lead, iodine, iodide of potassium, croton oil, prussic acid, sulphuric acid, arsenic and foxglove. Some have asserted that fœtor of the breath, a brassy taste in the mouth, and spongy and ulcerated gums, would indicate the salivation caused by mercury: but these characters have been equally met with in the salivation produced by bismuth.

Corrosive sublimate, as well as other mercurial preparations, is liable to produce gangrene of the mouth and fauces, a state which may equally occur from spontaneous causes: death is commonly the result. In a case of this kind, supposing any mercurial preparation to have been given medicinally, it may become a serious question, whether death actually resulted from the mercury acting as a poison, or from natural disease. Several fatal cases have occurred within the last few years, among young children; and the subject has become a matter of inquiry before coroners. Salivation and its sequelæ are said not to be common among young children, as an effect of mercurial preparations, except where there is idiosyncrasy; but notwithstanding this, it is clear, from the cases already recited, that small doses of mercury may have a most violent effect on young subjects, and render the suspicion of poisoning probable. Of two children, whose deaths became the subject of investigation, under these circumstances, one was affected with hooping-cough, and the other with measles. Powders containing calomel, were prescribed in both cases,—gangrene of the mouth followed, and the children died. There was some reason to believe, from the evidence, that the mercury had really produced the effect attributed to it at least in one of the cases. It is proper to observe, that this kind of disease, gangrene of the mouth, has been observed to occur in children, to whom no calomel nor any mercurial preparation whatever, had been exhibited:—the subjects have been observed to be chiefly young infants, badly fed and clothed, and generally labouring under, or recovering from, fever, small-pox, measles, or hooping-cough. Many cases of this kind are reported by Dr. Hennis Green, (See Lancet, Dec. 1839,) and others. The disease has often been described under the name of "*cancrum oris.*" A case occurred in August, 1840, in which a charge was made against a medical practitioner of having caused the death of a child, aged four years, by administering an over-dose of some mercurial preparation. The child was labouring under hooping-cough, some medicine was prescribed; but on the fourth day, the child complained of soreness of the mouth, the teeth became loose and fell out, the tongue and cheek were very much swollen, and the child died in the course of a few days from gangrene in the left cheek. The answer to the charge was, that not a particle of mercury had been exhibited, a fact clearly proved by the production of the prescription-book of the medical attendant. This then was a case where the gangrene proceeded from spontaneous causes; and yet it is almost certain, that had any mercury been proved to exist in the medicine prescribed, a verdict affecting the character of the practitioner would have been returned. In several instances, where but a small quantity of mercury had been exhibited, the disease and death were referred to it;—the cause appeared so obvious, that the general impression could not be shaken by the medical statement, that similar cases had occurred where no mercury was used. Sometimes the case may be of a doubtful nature. A boy aged three years, while suffering under an attack of measles, took small doses of mercury by the prescription of a physician. Soon after the administration of the medicine, the child became worse, the mouth became inflamed, dark and discoloured, and the teeth dropped out. He died in a few days. A practitioner who had been called in, pronounced that the child had been excessively salivated. Mercury had undoubtedly been taken, and it was proved, that the person who had dispensed the medicine, did not weigh it. An inquest was held, and a verdict returned, that the child had died from an overdose of mercury. It is worthy of remark, that in cases of this description, the popular opinion is generally supported by that of some medical practitioner, showing how easily members of the profession, as well as the public, are led to refer the effects to what in many instances is only an apparent cause. A child aged about four years, suffering from hooping-cough, took, according to a prescription obtained from a dispensary, three grains of calomel on the 29th of October: this dose was repeated five times between that date and the 7th of November following. About this time the right cheek became much swollen, and there was great difficulty in opening the mouth, with very offensive breath. The gums and inside of the cheek became ulcerated, and on the 16th a sphacelus appeared on the right cheek of the size of a shilling, which rapidly extended, and the child died on the 28th. This was considered to be a case of cancrum oris from spontaneous causes; but it would be difficult to say that the calomel had not here been the exciting cause. At any rate, it cannot be denied that there was reasonable ground for suspicion.

Are there any means of distinguishing gangrene as a result of disease, from the gangrene produced by mercury? A diagnosis has been founded on the allegation, that when the gangrene is caused by mercury, it is uniformly diffused over the gums, tongue and internal parts of the cheek; while, when of a spontaneous character, it is restricted to one patch or spot. This, however, is a very weak criterion. In a case recorded by Dr. Christison, where it resulted from mercury, the gangrene was observed to occur on the skin, near the mouth on each side: it thence spread over the whole of the cheek, and destroyed life in eight days. In general, however, it begins in the mouth or in the throat, and spreads onwards. Besides, it is quite possible that the spontaneous gangrene may present a diffused character. There is no certain diagnosis; at least, there are no general rules to guide a medical opinion: each case must be judged of by itself. The time of the occurrence of the symptoms, after taking the medicine, may be sometimes a good criterion; but this is not always applicable, for, by mere coincidence, the symptoms may supervene without being connected with the medicine. Then again, the symptoms may not have been caused, but aggravated by the continued use of mercurials. The fact of the dose of calomel, or other preparation, having been small, is no obstacle to the admission of the view, that it has really caused the gangrene; since cases have been already related, which show that in certain constitutions small doses of mercury have produced the most alarming and unexpected effects. Unless, then, a medical witness is prepared to assert, that no such idiosyncrasy could have existed in the case under investigation, it will be considered, when other facts concur, that the smallness of the dose is no answer to the charge of the medicine having produced these serious consequences. It is also not improbable, that the diseases under which such subjects have been observed to labour, may aggravate the effects of mercury so administered, and render them more prone to diseases of the salivary organs.

POST-MORTEM APPEARANCES.—These, as in the case of arsenic, are chiefly confined to the alimentary canal. Corrosive sublimate, however, affects both the mouth and fauces; the mucous membrane is softened, and of a white or blueish grey colour; that lining the œsophagus is similarly affected, and partially corroded and softened. The mucous membrane of the stomach is more or less inflamed, sometimes in patches; and there are masses of black extravasated blood found beneath it. Occasionally the whole cavity has a slate-grey colour from the partial decomposition of the poison by the membrane itself; beneath this the mucous coat may be found reddened. This grey tint of the mucous membrane has been considered by some to be indicative of the action of the poison on the lining mucous membrane; but it is not always present. In a recent case at Guy's Hospital, the mucous membrane was simply inflamed, and very much resembled the condition presented in cases of arsenical poisoning. The coats of the stomach are sometimes corroded, and so much softened that they cannot be removed from the body without laceration. Similar appearances have been met with in the small intestines and rectum. Perforation of the stomach is very rare as an effect of this poison: there is, I believe, only one case on record. Certain morbid changes have been found in the urinary and circulating organs, but these are not by any means characteristic of this variety of poisoning.

Appearances like those described, have been seen, not only where the case has terminated fatally in a few hours, but where it has been protracted for six, eight, and eleven days respectively.

Cases of poisoning by the *external* application of corrosive sublimate are rare; it acts energetically through the unbroken skin, producing severe local and constitutional symptoms, and even death. Two fatal cases of this kind have been reported by Mr. Ward of Bodmin. (Med. Gaz. iii. 666.) A man aged twenty-four, rubbed over every part of his body, one ounce of corrosive sublimate, mixed with six ounces of hog's-lard, for the purpose of curing the itch. In an hour, he suffered from excruciating pain in the abdomen and over the whole of his body;—he said he felt roasted alive,—he also suffered from intolerable thirst. The skin was found completely vesicated. He died on the eleventh day, having suffered from bloody vomiting, purging, and tenesmus. Ptyalism did not show itself until thirty-six hours after the application of the poison.

The brother of the deceased, aged nineteen, rubbed in the same quantity of the poison. The symptoms were much the same, but more aggravated. There was constant vomiting, with complete suppression of urine and frequent bloody stools;—the ptyalism was not so severe. He died on the fifth day. On inspection, the stomach was found much inflamed, and partially ulcerated. The small intestines were also greatly inflamed throughout; and the lower portion of the colon and rectum were in a state of mortification. The bladder was contracted, and without urine. Thirty large worms were found alive in the stomach and intestines!

QUANTITY REQUIRED TO DESTROY LIFE.—This is a question which it is somewhat difficult to answer with any degree of certainty, since it is only by accident that the quantity taken, can be ascertained. A child aged three years died in twenty-three days from the effects of twelve grains of corrosive sublimate. The smallest dose which has destroyed life was three grains. This was also in the case of a child, and the quantity was accurately determined from the fact of its having been made up by mistake for three grains of calomel, which the physician intended to order. It is probable that from three to five grains would destroy an adult. In its power as a poison it is therefore somewhat similar to arsenic. Persons have been known to recover, who had taken very large doses, where remedies were timely administered, or vomiting promoted. In one instance, lately recorded in the Journal de Pharmacie, a man recovered in three days after having taken one drachm of the poison; and in the Medical Gazette (xiv. p. 63,) Dr. Booth mentions a case where an ounce of corrosive sublimate had been swallowed after a full meal; and by timely vomiting, the subject of this rash act escaped with comparative impunity.

PERIOD AT WHICH DEATH TAKES PLACE.—In an acute case, an individual commonly dies in from one to five days. But death may take place much sooner and much later than this. A person has been known to die from the effects of the poison in eleven hours; and in one instance, of a child two years old, by whom twelve grains had been taken, death probably occurred in six hours. A case is reported by Niemann, in which a child, aged seven, was killed in three hours by eighteen grains of corrosive sublimate. The shortest case on record, although the period is only inferential, I believe to be the following, which occurred to Mr. Illingworth. (Med. Gaz. xxxi. p. 557.)

A man æt. 30, was found dead on the 4th December, 1842, at half-past seven A. M. He had vomited some half-digested food, mixed with blood and mucus. On a shelf near him was a drinking-horn, containing about three drachms of corrosive sublimate. It was ascertained at the inquest that he had died from the effects of this poison. He had put water into the drinking vessel, and had probably swallowed the poison while thus loosely suspended,—the exact quantity taken could not be ascertained. The deceased was last seen alive at half-past eleven the preceding evening; therefore only eight hours before he was found dead. When discovered, the face, as well as the extremities, were cold. From all the circumstances, it was inferred that even admitting the deceased to have taken the poison immediately after he was last seen alive, he could not have been dead less than six hours. This would carry the duration of the case to *two hours* from the time of taking the poison. There is probably no instance in which the poison has acted with greater rapidity than in this.

Mr. Bigsley has published a case which proved fatal in two hours and a half; but the poison was a solution of the nitrate of mercury, not corrosive sublimate. On the other hand, the case may be protracted for several days: the following cases will not only shew this, but will also prove that the time at which the poison destroys life, cannot be inferred from the quantity taken. In a case related by Dr. Venables, two drachms of the poison killed a woman in eight days,—about the same quantity destroyed life in six days, in a case that occurred to Mr. Watson of Edinburgh. In a third, reported by Sobernheim, three drachms did not kill for eleven days; while in an instance, recorded by Niemann, (Tasch d. Arzneyw, 452), where one ounce of the poison was swallowed, the person did not die until the sixth day.

TREATMENT.—If vomiting does not already exist, it must be promoted by the exhibition of emetics. Various antidotes have been suggested for this poison; and among these, albumen mixed with water, is perhaps the best fitted to counteract the effects of the poison. This remedy was proposed some time since by Taddei, an Italian chemist: and there are many instances of its efficacy on record. It appears to have had good effects, even when it was not taken until some time after the poison had been swallowed.

A man, aged sixty-eight, swallowed a drachm of corrosive sublimate. The usual symptoms appear to have followed, but he was not seen until about three quarters of an hour had elapsed. His countenance was pale and anxious;—his extremities cold, and the pulse small, hard and frequent. Emetics were given to him, with the whites of six eggs, and after vomiting violently, he recovered in three days. There was some reason to suppose that the effect of the antidote was aided by the application of other remedial means.

Different opinions have been entertained on the nature of the compound, formed by the mixture of albumen with corrosive sublimate. Lassaigne supposes that it is a direct combination of the two bodies, forming an insoluble compound, which contains six per cent. of the bichloride of mercury. The opinion of Orfila is more commonly received—that the poison is converted either in great part, or entirely, to calomel, and is in this form united to albumen. From some experiments performed on the subject, I find that unless well-washed, peroxide of mercury is separated from it by potash. When thoroughly washed, the compound is white, of the consistency of paste, and perfectly insoluble in water. I have kept it in this state for five years, without its undergoing any change. When a portion was digested in potash, a black precipitate separated from it, and protochloride tin turned it immediately of a deep slate colour. These results bear out the view of Orfila, that the bichloride does not combine with albumen as such, but undergoes a chemical decomposition. One fact seems to be admitted by all, that it is destitute of active poisonous properties, and therefore is well fitted to serve as an antidote for this poison.

Taddei has also recommended gluten as a substance which still more effectually decomposes the poison. Barzellotti relates the following case in proof of its efficacy. Some powdered corrosive sublimate had been accidentally mixed with calomel in an apothecary's shop, and one of the assistants, by mistake, swallowed eight grains of the poisonous mixture. He was immediately aware from the taste, that he had swallowed the poison, and some gluten being kept ready prepared in the shop, this was immediately administered to him, mixed with water. Vomiting and purging followed, and in the vomited matters portions of a dense white substance were seen, which were supposed to be a compound of calomel and gluten. He was soon restored, although he suffered for some days from swelling of the tonsils and difficulty of swallowing. (Medicina Legale, t. ii. 111.) Gluten may be prepared by washing flour in a muslin bag, under a current of water. Should the case be urgent, the flour may be at once exhibited in the form of paste mixed with water. Gluten may often be obtained in this way, when albumen is not at hand.

These remedies cannot be expected to be always successful: the sooner they are exhibited, the greater is the hope of success. Dr. Buckler, of Baltimore, relates the case of a young man who took about fifty-five grains of corrosive sublimate in a state of perfect solution, and albumen to the amount of a quart was afterwards administered to him, but nevertheless he died on the eighth day. This gentleman has lately recommended the employment of a galvanic antidote, —namely, a mixture of fine gold-dust and iron-filings diffused in water, containing gum and slightly acidulated. (Lancet, Jan. 22, 1842.) It has been found that a solution of corrosive sublimate is precipitated entirely in the form of mercury, when gold-dust and iron-filings are added to it; but in practice, this mixture has failed as an antidote. Orfila reports unfavourably of it. (Ann. d'Hygiene, Oct. 1842.) He has found that when given in large quantity, it has not prevented animals dying within the usual time from the effect of the poison. More recently M. Mialhe has strongly recommended the hydrated protosulphuret of iron, which while it is inert produces with corrosive sublimate, protochloride of iron and bisulphuret of mercury. The protosulphuret may be made by adding hydrosulphuret of ammonia to a solution of protosulphate of iron, and washing the black precipitate without exposure to air. Orfila has lately tried some experiments with it on animals, and he has found that when exhibited speedily after the poison has been taken, it possesses even greater antidotal powers than albumen. Further observations on the human subject are required in order to confirm its efficacy as an antidote.

In all cases, the entire expulsion of the poison from the stomach, should be looked to by the practitioner; and the antidote, whether albumen or gluten, may be given to aid the efforts at vomiting. The use of the stomach-pump is of questionable propriety; since the parietes of the œsophagus and stomach are commonly softened and corroded, so that very slight force in its employment might lead to perforation.

CHEMICAL ANALYSIS.—We will first suppose that the poison is in the *solid* state, and in the form of a white powder. 1. A small quantity heated on platina foil is entirely volatilized at a moderate heat,—in this property corrosive sublimate resembles arsenic, but it differs in all other respects. 2. It is very soluble in water,—if the water be warmed the powder will dissolve instantly. 3. A small quantity of the powder dropped into a white saucer, containing a solution of iodide of potassium, is turned of a bright scarlet colour. 4. Dropped into potash in a similar way it is turned of a yellow colour. 5. Into a solution of hydrosulphuret of ammonia, it is turned black. 6. When a few grains are rubbed on a clean surface of copper, with a mixture of one part of muriatic acid, and two parts of water, a bright silvery stain is produced, which is entirely volatilized by heat. If zinc or tin-foil be used instead of copper, the surface acquires a silvery lustre, and the metal becomes remarkably brittle. 7. When mixed with three or four parts of calcined carbonate of soda and heated in a reduction tube similar to that employed in the analysis of arsenic, the metal is reduced; and a ring of bright globules of mercury is formed, while common salt remains in the tube. For the success of this experiment, the materials must be quite dry, and the tube at first gently heated; any undecomposed corrosive sublimate that may be sublimed, should be driven higher up in the tube, before finally applying a strong heat, so that the ring of mercury may not be obscured by it. This last experiment is conclusive of the nature of the substance, as mercury, being the only liquid metal, is the only metal which sublimes in globules. The properties mentioned under 1, 2, and 5, are possessed in common by other bodies; but the other characters are peculiar to the persalts of mercury; and when the results agree, render it absolutely certain that the powder must be a persalt of that metal. There are therefore no *objections* to this mode of analysis. The experiment of reduction will answer with any visible quantity of the poison.

The weight of the metallic sublimate may be determined in the same way as that of arsenic. Oxalate of soda has been recommended for the reduction instead of the carbonate of soda; but this answers the purpose much better than the oxalate. Neither pure potash, nor pure soda, can be so conveniently employed. An excellent reducing agent has been lately proposed by Dr. Frampton, (Med. Gaz. xxxii. 384,) namely, metallic silver in a fine state of division. It is procured in decomposing the solution of nitrate by slips of copper; and it only requires washing in a solution of ammonia and water. If three or four parts of this pulverulent silver be mixed with one part of corrosive sublimate and heated in a reduction tube,—a ring of metallic mercury is readily obtained; and the decomposition of the poison appears to be more perfect than when carbonate of soda is employed, since none of it escapes decomposition. By using a tube of very minute bore, the smallest visible quantity of corrosive sublimate may be thus easily reduced. There is, however, a more ready way of obtaining metallic silver for this purpose than that above proposed, namely, by heating on platina foil the tartrate of that metal previously reduced to a fine powder; or the method for obtaining pure silver, lately proposed by Dr. Gregory, may be adopted. Boil the freshly precipitated chloride of silver in caustic potash until all the white particles disappear, wash the resulting oxide in water, dry it and heat it in a platina capsule. (L. & E. Phil. Mag. April, 1843.)

Corrosive sublimate in solution in water. — It is very soluble in water, forming a clear solution which, when concentrated, has a faintly acid reaction and a strong metallic taste. A small quantity of the solution may be first gently evaporated on a slip of glass, and then set aside to crystallize. If it be corrosive sublimate, it forms slender opake silky prisms, sometimes of considerable length and intersecting each other. When a solution of iodide of potassium is dropped on them they acquire a bright scarlet colour, and chloride of potassium is formed. These characters, which may be obtained from one drop of solution, prove that the body dissolved in water is corrosive sublimate; it is thus distinguished from every other mineral poison, and all other substances whatever.

Tests.—1. Potash. On adding a small quantity of caustic potash to the solution, a reddish coloured precipitate falls, becoming yellow by the addition of a larger quantity of alkali. This precipitate, when washed, dried and heated in a reduction tube, yields a well-defined ring of metallic mercury. The filtered liquid will be found, on being tested with nitrate of silver, to contain chloride of potassium, thus proving that the mercury was in the state of bichloride,—this being the only chloride soluble in water. 2. Protochloride of tin. On adding this test in rather large quantity to the solution, a white precipitate at first falls down, (calomel,) becoming speedily of a slate-grey colour, and afterwards almost black. On warming the liquid, it soon becomes clear, while a heavy precipitate, in great part formed of pure metallic mercury, falls to the bottom of the vessel. The mercury may be collected by pouring the liquid on a filter, and afterwards warming the filter; or its presence may be easily demonstrated, by pouring the water carefully from the precipitate, and forcing down upon this a slip of bibulous paper;—this absorbs the water from the mercury, and the pressure condenses the metal into one or more well-defined globules. 3. Sulphuretted hydrogen gas. This gives at first a precipitate, partly black and partly white, (chlorosulphuret,) becoming entirely black, when the current of gas has been allowed to pass in for some time. Hydrosulphuret of ammonia gives a similar precipitate in the solution;—thus clearly distinguishing corrosive sublimate from arsenic. The precipitated black sulphuret of mercury, dried and heated with carbonate of soda, easily furnishes a ring of pure metallic mercury. 4. Precipitation by metals. If we acidulate the liquid with a few drops of diluted muriatic acid, and introduce a slip of bright copper, it is soon coated with metallic mercury; should the poison be in small quantity, this has a silvery metallic lustre, but if in large quantity it is of a dark grey colour. On heating the slip of copper in a reduction tube, the mercury may be obtained in well-defined globules. If instead of copper we employ finely powdered silver as recommended by Dr. Frampton, the results are much more satisfactory, and a larger quantity of mercury is procured in the sublimate. Pure tin or finely laminated zinc may be also usefully employed. While the zinc acquires a silvery whiteness, it becomes brittle, and when broken up and heated in a reduction tube, an abundant sublimate of metallic mercury is obtained. 5. The galvanic test. There are various ways in which galvanism may be applied to the detection of mercury in corrosive sublimate. Dr. Wollaston, on one occasion, employed an iron key and a guinea: he placed a drop of the suspected solution on a surface of gold, and touched it and the gold with a key:—the mercury was deposited on the gold in a bright silvery stain. The following is a ready means of producing the metal. Place a few drops of the solution on a clean surface of copper, and slightly acidulate with muriatic acid;—then touch the copper through the solution with a slip of zinc foil. Wherever the copper is touched by the zinc, the mercury is deposited, and on washing the surface with dilute muriatic acid a silvery stain is left, which is immediately dissipated by the heat of a spirit lamp, thus proving it to have been derived from a volatile metal. This experiment may be modified by twisting a slip of zinc round a slip of bright copper, and introducing them into the liquid. Mercury is deposited on both. A surface of gold with zinc foil is, perhaps, more delicate than a surface of copper as a test of the presence of mercury. Applied in a way to be presently explained, it will detect the metal when nearly every other method fails. Other tests have been proposed, but I omit all notice of them, because the foregoing are, in my opinion, quite sufficient for every practical purpose.

It may be proper to mention here the relative action of these tests. The protochloride of tin added to the 8640th of a grain of corrosive sublimate dissolved in one drop of water in a minute tube, produced a dark grey discolouration, from which in twenty-four hours a black substance separated. This, however, was in such small quantity that it was impossible to determine whether or not it contained any mercury. This test added to one fluid-drachm of water holding dissolved the 144th of a grain of corrosive sublimate, produced great turbidness, and a finely divided precipitate fell down in twenty-four hours. From this precipitate it was found impossible to procure any portion of metallic mercury. On an equal quantity of the same solution, iodide of potassium had no effect whatever; but the hydrosulphuret of ammonia gave a dark greenish black colour without any decided precipitate. Coils of gold and zinc foil, and of copper and zinc foil, which failed to detect the 8640th grain in the smallest possible quantity of water, were now introduced into two quantities of liquid containing each the 144th of a grain in one fluid-drachm, and a drop of dilute muriatic acid was added. There was no apparent change for several hours. After twenty-four hours the copper and gold were coated, the former having a bright silvery lustre. The film of mercury on the copper was so thin that no globules could be obtained on heating the metal in a reduction tube. From the gold and zinc, however, two well-defined globules of mercury, perceptible only by the aid of a lens, were procured. These are perhaps the limits of the application of the tests for this poison; and it would appear therefore that by the galvanic test we may procure clear evidence of the presence of mercury in cases where the protochloride of tin fails to separate it in a distinctly recognizable form. With respect to the silver test of Dr. Frampton, it is very delicate, and perhaps only inferior to the gold and zinc. I found in my experiments that no mercurial sublimate was obtained, where the quantity of corrosive sublimate was the 144th of a grain in one fluid drachm of water; and this was after long boiling, and several hours' contact. Dr. Frampton does not appear to have operated on less than a grain of the poison, confining himself merely to the effects of dilution; but he found that the silver test enabled him to detect mercury where the quantity of corrosive sublimate was no more than one grain in eight fluid ounces of water. There is no doubt that this test is sufficiently delicate for all practical purposes. Before we employ it we should satisfy ourselves that the silver contains no mercury, by heating a portion of it in a reduction tube.

Objections.—Among the foregoing tests, there is only one to which any objection can be offered, namely, 3. Sulphuretted hydrogen gas, or hydrosulphuret of ammonia. Either one or both of these re-agents will give a black or dark brown precipitate with several metals, as for example with the salts of lead, copper, bismuth, silver, nickel and some of the compounds of tin. The precipitate derived from mercury is, however, distinguished from all the others, by the fact that it yields that metal when dried and heated in a tube with carbonate of soda. Again the objection is at once answered by the fact, that the other tests are conclusive of the presence of a mercurial salt: it could only apply where the production of a black precipitate from sulphuretted hydrogen was alone relied on as evidence of the presence of a mercurial salt.

Hitherto it will be seen, that the analysis has been chiefly confined to the demonstration of the mercury. In speaking of the potash test, the means of proving the presence of chlorine were pointed out: but the nitrate of silver may be at once added to a solution of the poison itself. It has been said that this is objectionable, because calomel is also precipitated. Admitting that this is the case, still the test is equally applicable; because there is no other soluble salt of mercury which gives a precipitate with nitrate of silver, insoluble in nitric acid, except the bichloride or corrosive sublimate.

In liquids containing organic matter.—These remarks here made on the analysis, will also apply to the vomited matters and contents of the stomach. Masses of corrosive sublimate may be sometimes locked up in thick viscid mucus, and in such cases, the powder being heavy, it may be sometimes separated by simply agitating the viscid liquid in water. This poison is decomposed and precipitated by many organic principles, such as albumen, fibrin, mucous membrane,—also by gluten, tannin and other vegetable substances. Thus then we cannot always expect to find it in a state of solution. We must filter, in order to separate the liquid from the solid portion, and our first object will be to determine whether any of the poison is held in solution. If the liquid be clear, the protochloride of tin may be used as a trial test: if an abundant grey precipitate is formed,—the poison is probably present in large quantity. I have found occasionally useful as a trial test, the galvanic reduction of a portion of the liquid on copper foil, by means of zinc and a small quantity of dilute muriatic acid. Supposing that one or both of these tests give strong evidence of the presence of mercury dissolved, we may add to the liquid one-third of its bulk of ether in a bottle, and agitate the mixture. On allowing it to stand some time, the greater part of the ether will rise to the surface, holding dissolved the corrosive sublimate, which was contained in the organic liquid. This may be separated by a funnel or pipette;—distilled in a retort, and the corrosive sublimate recovered in a pure state. This process, which was first suggested by Dr. Christison, I have found to answer only where the corrosive sublimate was in moderately large proportion. If none should be thus procured, the following method will detect mercury, even when present in small quantity; and this plan of course applies to all those cases, where the trial tests fail to give any satisfactory indications of the presence of the poison. Cut a slip of fine gold foil of about one inch in length and one-eighth of an inch in width; it should be just large enough to enter into a small reduction tube. We must twist round this, in a spiral form, a narrow slip of finely-laminated zinc; we then acidulate the suspected liquid with a few drops of diluted muriatic acid, and suspend the gold and zinc by a thread in the midst of it. According to the quantity of mercury present, the gold will be coated of a grey colour, either immediately or in the course of a few hours. If at the end of five or six hours, the gold retains its bright yellow colour, there is no mercury present, or the quantity is too minute to be detected. Supposing the gold to have lost its colour, owing t its having become completely coated, we should remove it and dip it in ether and afterwards in distilled water, to wash off any corrosive sublimate and organic matter adhering to it: it should then be dried without being allowed to touch any surface, and introduced into a reduction tube. The zinc may be in part dissolved; but as mercury is also deposited on this metal, whereby it is commonly rendered quite brittle, it may be introduced with the gold into the tube. On applying heat, a fine sublimate will soon appear in the cool part of the tube, which, if not perceptible to the eye, may be easily seen by the aid of a common lens, to consist of minute globules of mercury. Slips of fine copper, with or without zinc attached, or slips of pure laminated zinc alone, may also be employed as a substitute for gold; but in this case, after removing the metals, it is necessary, not only to wash in water, but in a solution of ammonia, in order to remove from the mercury any adhering salt of copper. Devergie has recommended tin;—but this metal appears to possess no advantage over the others, and common tin is said to be often contaminated with mercury. There is no doubt that the silver test of Dr. Frampton is preferable to the use of either tin or copper in this experiment. A few drops of an organic liquid, containing corrosive sublimate, which was prepared five years before, yielded, on boiling it with metallic silver and muriatic acid, satisfactory evidence of mercury in the course of a few minutes. Dr. Frampton recommends that the deposit should be boiled in potash to remove organic matter, and then digested in ammonia, to dissolve only the chloride of silver formed:—but there is an objection to this in the fact, that potash, on boiling, reduces the chloride to oxide of silver, and this, with ammonia, might produce a fulminating compound. The ammonia should therefore be first employed. I have found that simple washing in water was commonly sufficient. The reduction by silver would be convenient, where the quantity of organic liquid was small; but otherwise wo should prefer the use of gold and zinc. Should there be any difficulty in procuring stout gold foil for this experiment, copper covered with a layer of gold will answer equally well. Copper foil may be gilt by the ordinary process of electro-gilding, using the cyanide of potassium as the solvent for gold; or slips of copper and fine copper wire coiled up may be covered with a thin film of gold, by boiling them for twenty minutes in a solution of chloride of gold, to which crystals of bicarbonate of potash have been added in excess. This mixture must be boiled for half an hour before it is used for gilding; and the copper should be thoroughly cleaned by plunging it into diluted nitric acid, before it is introduced. Platina may be substituted for gold in this experiment, and gold or platina wire may be used instead of the laminated metals; but the great advantage of gold is that we can note the degree and rapidity of deposition by the loss of its bright yellow colour.

It may be objected, that this galvanic process only proves the presence of mercury: but a medical jurist can seldom do more. It would show that mercury was present in some soluble form; and the only common soluble salts of this metal are both highly poisonous,—namely, the bichloride and pernitrate:—whether the substance had acted as a poison or not, would be determined from symptoms and post-mortem appearances:—whether it had been given or intended as a medicine or not, would be easily determined from other circumstances. The only way to prove that the mercury was really in the form of corrosive sublimate, would be either by the discovery of some undissolved portions of the solid poison in the stomach or its contents:—or by a separation of the poison, when actually in solution, by means of ether. The addition of nitrate of silver to the contents of the stomach, or to an article of food, in order to detect the chlorine, would be in the highest degree objectionable; since the nitrate of silver is not only precipitated abundantly by most kinds of organic matter, but also by common salt, which, if not taken as an article of food, is always present in the gastric secretions. Such an experiment might in certain cases be the basis of a chemical suspicion of the nature of the mercurial compound, but not of a medico-legal opinion.

Let us suppose that the filtered liquid contains no trace of a mercurial salt, we must now direct our attention to the analysis of the insoluble matters separated by filtration. These may be boiled in distilled water, the liquid filtered and tried by ether; if this does not succeed, it may be tried by the galvanic test. I have found that most of the compounds, which corrosive sublimate forms with organic matter, yield commonly sufficient poison for detection by boiling them in water when the analysis has not been long delayed. But supposing that the solid matters,—even comprising the stomach itself, cut into pieces,—yield no traces of the poison, it will then be difficult to obtain evidence of its presence;—the following process, which will answer for the detection of mercury only, may then be resorted to.

Evaporate the organic substances to perfect dryness, and digest in warm nitro-muriatic acid. (Orfila recommends them to be first charred by the agency of sulphuric acid, but this does not appear to be absolutely necessary.) This acid will dissolve out any of the decomposed poison and reconvert it to the state of bichloride: it will also destroy the organic matter. The acid liquid may be evaporated to dryness, the residue taken up by water, filtered and tested by the galvanic test. If the poison be still in the state of bichloride, Dr. Geoghegan has suggested that nitric acid only may be used, as this destroys the organic matter without chemically affecting the corrosive sublimate. In some cases potash may be usefully employed, as this alkali will dissolve some kinds of organic matter and set the oxide of mercury free.

Dr. Christison has recommended the use of protochloride of tin as a precipitant. If this be used, the precipitate should be well boiled in strong muriatic acid, and afterwards in potash in order to separate from it any oxide of tin and organic matter. This process is indispensable, when we wish to ascertain the total quantity of mercury present, so that the quantity of corrosive sublimate may be determined. When the protochloride of tin does not give a precipitate in a suspected liquid, it is pretty certain that no mercury will be detected either by the galvanic or any other test. When the quantity of poison is small I have found that there is much trouble and some risk of loss in attempting to separate the mercury by the protochloride of tin, and that it cannot be readily done. By means of the galvanic test, I was enabled to detect the one sixteenth part of a grain of corrosive sublimate dissolved in one ounce of an organic liquid, and to obtain the metallic mercury from it in less than half an hour. The deposition on the gold was slow, but the mercury was entirely accumulated on the metal. Protochloride of tin gave an abundant precipitate with the same proportion of poison, but it was a much more troublesome and tedious process to obtain the mercury from the precipitate.

It is not possible to conceive a case where, in an analysis of this kind, the galvanic test would not be immediately applicable. This it will be observed is merely the medium for furnishing a ring of pure metallic mercury, and, as in the case of arsenic, it is not so much from the quantity of arsenic we obtain by the reduction process, as by the clear and undoubted evidence of its presence, from the physical and other properties of the metal;—so in the case of corrosive sublimate, it is not necessary to precipitate all the mercury in a given organic mixture, in order to say that that metal is there present. Thus, then, if from an organic liquid, by means of the galvanic test, we can obtain a distinct sublimate of mercury, we need not employ either the protochloride of tin or sulphuretted hydrogen gas, to separate the whole of the poison, unless our object be to determine the actual quantity present. An arsenical sublimate weighing less than 1-50th part of a grain, is evidence of the presence of that metal; the same is true of mercury, however the sublimate may be procured; and an operator has no more occasion to obtain all the mercury from the corrosive sublimate contained in a stomach, than he has to obtain all the arsenic from the arsenious acid diffused through the stomach and intestines in a case of arsenical poisoning.

Corrosive sublimate is not easily lost in organic liquids, when it is in moderate quantity. A few grains of this poison were mixed with some ounces of albumen, gruel, and porter, in January, 1839. An abundant precipitate was formed. The mixture has been loosely exposed for nearly five years: but the poison is now easily discovered by the protochloride of tin, by the galvanic test, and by metallic silver both in the supernatant liquid and in the precipitate.

Corrosive sublimate is not always found in the stomach of persons poisoned by it, although, from its readily combining with the mucous membrane, it is more likely to be detected than arsenic. In a well-marked case, which occurred to Mr. Watson, where two drachms killed a person in six days, none was found on a chemical analysis of the contents. This may have been partly due to the length of time that had elapsed. In Mr. Illingworth's case, where probably less was taken and death occurred in two hours, it was freely detected in a state of solution.

If a person has died under symptoms of mercurial poisoning, it will generally be sufficient that the chemical analysis should show that mercury was present in the contents of the viscera. In what form the mercury was taken, is a fact which must be proved by other circumstances: but it may be objected, whenever mercury is found in an insoluble state in the viscera or their contents, that it had been derived from some mercurial preparation administered medicinally, such as calomel, blue pill, or grey powder. This must be admitted: as the specific poison is not, in such cases, readily susceptible of detection; but the very obvious answer is, that symptoms and post-mortem appearances indicate the fact of poisoning, and the analysis is merely corroborative. Besides, no mercurial preparation may have been taken by the deceased. The discovery of a *soluble* compound of mercury in any suspected organic liquid, whether administered or not, must always remove the suspicion of its being derived from a medicinal preparation; if corrosive sublimate have itself been used as a medicine, it will be sufficiently apparent from circumstances. Besides the dose in such cases is always extremely small.

Corrosive sublimate is considered to be one of those poisons which are absorbed into the circulation; but chemists have in vain endeavoured to detect mercury in the blood, secretions, and soft organs of animals poisoned by it. According to Sobernheim, where mercurial preparations have been taken a long time medicinally, for producing salivation, mercury has been found in the blood, urine and saliva, and some facts would lead to the supposition that it is eliminated in the cutaneous transpiration. (Op. cit. p. 243.)

A man lately died in Guy's Hospital, four days after having swallowed two drachms of corrosive sublimate in a solid state. No mercury could be discovered in the contents of the stomach. I examined, in different experiments, the whole of the spleen which was of unusually large size,—five ounces of blood, and the serous liquids of the pericardium and peritoneum, amounting in each case to two drachms: but in no instance was any trace of mercury discovered by the galvanic test; although I satisfied myself by the addition of less than one sixteenth part of a grain of the poison to the pericardial liquid, that the mercury could be detected in the course of a few minutes. The plan pursued for the detection of the metal consisted in drying the substance,—decomposing it by nitro-muriatic acid,—evaporating to dryness,—redissolving in water,—nearly neutralizing the surplus acid, and suspending in the clear filtered liquid, gold and zinc. M de Kramer states that he has lately detected mercury in the blood of a person who had taken the sulphuret medicinally, but the particulars are not given. (Ann. d'Hyg. April 1843, 428.) In an experiment lately performed on a dog, in which half an ounce of the poison was given, the œsophagus tied, and death took place in an hour, Dr. Glover examined the heart, and eight ounces of blood taken from the animal. He thought the tests indicated the presence of mercury, but as the metal was not procured, it is left uncertain, whether it really was present in the blood or not. (Ed. Med and Surg. Jour. Oct. 1842.)

Quantitative analysis.—If the poison be entirely in a soluble form, we may procure the mercury from a part only by the protochloride of tin and calculate the remainder proportionably. If it be in an insoluble form, we must then pursue the process recommended in the preceding page. and precipitate it entirely by the salt of tin, purifying the mercury by boiling it first in potash, and secondly in muriatic acid. For every 100 grains of metallic mercury obtained, we must allow 135 grains of crystallized corrosive sublimate to have been present.

Calomel. (Protochloride of mercury.)—This substance, although commonly regarded as a mild medicine, is capable of destroying life, even in comparatively small doses. Several cases have been already referred to, where excessive salivation, gangrene of the salivary organs and death, followed from the medicinal dose of a few grains. For an additional instance of this kind, I must refer to the Med. Gazette, (xviii. 484,) wherein a boy, aged fourteen, was killed in about three weeks by a dose of only six grains of calomel. It is singular that in this case, neither the teeth nor the salivary glands were affected; still, considering the effects of calomel in other instances, it seems most probable, that the ulceration and gangrene of the face were due to it. Pereira mentions the case of a lady who was destroyed by swallowing twenty grains of calomel, she having previously taken a moderate dose without a sufficient effect being produced.

Sobernheim states that a girl, aged eleven, took in twenty-four hours eight grains of calomel, for an attack of tracheitis, and died in eight days from inflammation and ulceration of the mouth and fauces. In another case, which occurred to Lesser, fifteen grains of calomel produced similar effects with excessive salivation, and this patient also died in eight days. (Op. cit. 253.)

There are many other fatal cases on record, and the facts seem to leave no doubt that calomel may act as an irritant poison. It was supposed that these effects might be ascribed to this compound being adulterated with corrosive sublimate; but Dr. Christison examined ten different specimens of calomel without finding so much as one five-hundredth of its weight of corrosive sublimate;—this would be less than a grain to an ounce; and in a common dose of three grains of calomel there would be no more than the one hundred and sixtieth part of a grain of corrosive sublimate,—a quantity insufficient to do mischief. (Ed. Med. and Sur. Jour. xlix. 336.) It has been further supposed that calomel might be converted into corrosive sublimate, by the pure muriatic acid in the gastric secretions; but the very minute proportion in which this acid exists in the gastric juice, according to Dr. Prout, renders this explanation improbable. (See post.)

It is a remarkable circumstance that calomel has often been taken in very large doses medicinally and accidentally, without producing dangerous consequences. Pereira states that upwards of five ounces of calomel were given in forty-two hours, to one cholera-patient, without producing any sensible effect. (Med. Gaz. xviii. 468.) It may be objected, however, that we are hardly entitled to draw a fair inference of its effects on a healthy person, from exhibiting it in cases of disease; since, as it is well known, opium itself may be given in poisonous doses, to persons affected with certain diseases, without any injury resulting. The following case shows, that even an ounce may be swallowed by a healthy person without serious effects resulting. A healthy girl, aged nineteen, swallowed about an ounce of calomel by mistake for magnesia. She took it in milk, and rinsed out the cup, so that the whole was swallowed except a few grains. The mistake was not discovered until two hours afterwards: she then experienced slight nausea and faintness. Emetics and lime-water were given, and in about half an hour, the larger portion of the calomel was discharged, mixed with mucus. Severe griping pains with tenderness of the abdomen came on; but in the course of four days, the girl had completely recovered without the salivary organs having become in the least degree affected. (Med. Gaz. July 1838.)

It is sufficient for a medical jurist to know that life has been destroyed by this medicine; and that death from calomel has become a subject of medico-legal investigation. In all such cases, it is likely that there will be some difference of opinion. For an interesting case of this kind, in which a man was tried for the murder of his wife, see Christison, (p. 384.)

It may be well inferred that, if calomel have an irritant action, the antidote for corrosive sublimate, albumen, or gluten, is nothing more than the substitution of one poison for another. But it must be remembered that the remedies above mentioned, convert a very energetic poison, into one, comparatively speaking, of far less activity.

There are various ways in which corrosive sublimate in solution may become partially decomposed and converted into calomel. Long exposure to light, especially of the alcoholic solution, is sufficient for this purpose. On the other hand, it is important to inquire in relation to a substance so extensively used for medicinal purposes, whether in some instances calomel may not become partly converted to corrosive sublimate within the body, and act as a poison. A case of some interest in relation to this point occurred recently in France. A physician prescribed for a child, powders, containing in each, five grains of muriate of ammonia, five grains of sugar, and half a grain of calomel. After taking a few of these powders the child died with all the symptoms of poisoning by corrosive sublimate; and the apothecary was charged with the death of the child, on the supposition that he had substituted corrosive sublimate for calomel. Experiments were instituted to ascertain, whether the calomel could have been decomposed by the ammoniacal salt; and it was satisfactorily proved, that a portion, at least, was converted into corrosive sublimate. M. Mialhe, who reports the case, has confirmed this result. He has found that calomel, when mixed with muriate of ammonia,—the chloride of sodium, (common salt,) or potassium and distilled water, is partly transformed into corrosive sublimate and metallic mercury. The decomposition he found to take place at the temperature of the human body, and even at the ordinary temperature in the course of a few seconds. The mercurial or metallic taste of calomel depends, according to this gentleman, on its partial conversion into corrosive sublimate by the alkaline chlorides in the saliva; and the quantity of sublimate formed within the body on the taking of calomel, will, therefore, depend on the quantity of alkaline chloride (salt) which it may meet with in the alimentary canal. (Ed. Med. and Surg. Journ. July 1840.) These facts are of some importance in relation to the administration of calomel as a medicine, more especially in conjunction with alkaline chlorides, or where much salt is introduced into the stomach as an article of food.

The following are the results of some experiments which I have made in respect to this alleged conversion of calomel into corrosive sublimate. A few grains of calomel were boiled for some minutes in a saturated solution of common salt; it became of a dark grey colour, and when the filtered liquid was tested, it gave the usual reactions indicative of the presence of a portion of corrosive sublimate. The solution was precipitated of a scarlet colour by iodide of potassium, which, as we have seen, is one of the weakest of the tests for this poison:—but at common temperatures the effects were widely different. 1. Fifteen grains of calomel were digested for two months in an ounce of diluted muriatic acid. The liquid when filtered gave, with protochloride of tin, a very faint cloudiness,—but not the slightest deposit of mercury took place in twenty-four hours, on introducing gold and zinc. 2. The same quantity of calomel was introduced into one ounce of a saturated solution of common salt:—after two months digestion protochloride of tin gave, with about one fourth of the liquid, a dark grey turbidness:—but by this means, no mercury could be procured. A piece of gold with zinc became, however, slightly coated in twenty-four hours, but iodide of potassium had no effect. This showed that only a very minute portion of corrosive sublimate could have been present. 3. A mixture was made of ten grains of muriate of ammonia, ten grains of sugar, and one grain of calomel, in one ounce of water. After a lapse of two months there was not sufficient corrosive sublimate formed, to conceal, by a deposition of mercury, the yellow colour of the gold, although the coil of gold and zinc remained in the liquid twenty-four hours. Here the quantities were twice as great as those contained in the powder. It might be objected that this change may be materially affected by temperature. In the above experiments the temperature had been about 55°:—but in another case, 4. a similar mixture, was kept for two hours by means of a water-bath at about 98°—the liquid was filtered and tested.—Protochloride of tin rendered a portion of it turbid, a slip of copper was faintly coated with mercury in twenty-four hours, but the yellow colour of gold was not entirely concealed by the application of the galvanic test. 5. In mixing the above materials with a small quantity of water at 60°, sufficient to form a kind of paste, the powder became grey in a few seconds, clearly indicating that the calomel was undergoing a partial conversion into corrosive sublimate. Admitting, therefore, that a change of this kind does take place, it seems to me very doubtful, whether the quantity of corrosive sublimate formed from a few grains of calomel, would be sufficient to produce symptoms of irritant poisoning or to cause death.

Besides, it has been already remarked that calomel itself is often mixed with corrosive sublimate. On boiling one grain in distilled water, filtering the liquid, and applying the tests for corrosive sublimate, more especially the protochloride of tin, effects very similar to those above described, although less in degree, were produced.

CHEMICAL ANALYSIS.—Calomel is commonly seen in the form of a white powder with a faint yellow tint, so insoluble in water, that it is said to require 12,000 parts to dissolve one part. It is also insoluble in alcohol and ether which may be thus usefully employed to separate from and detect in it, any traces of corrosive sublimate. Calomel, when long exposed to light, becomes deeper in colour: this is thought by some to be owing to its partial conversion to corrosive sublimate; but there is no evidence of any of this poisonous salt being thus produced. The specific gravity of calomel is much greater than that of corrosive sublimate; and owing to this property it is not difficult to separate it from organic liquids by decantation. Among the characters by which calomel may be identified, we may note the following:—1. Its insolubility in water;—it is soluble in strong nitric acid, but decomposed by it into corrosive sublimate and pernitrate of mercury. Strong muriatic acid transforms it to corrosive sublimate and metallic mercury. 2. When heated on platina over a spirit-lamp it is sublimed, but it is not so volatile as corrosive sublimate: during sublimation, it is partially decomposed into that substance and metallic mercury. 3. When dropped into a solution of iodide of potassium, it is slowly turned of a dingy green colour; 4. into a solution of potash, it is turned black. 5. It is also turned black by a solution of hydrosulphuret of ammonia. 6. It gives a silvery stain when rubbed on clean copper with a diluted acid. 7. It yields a ring of metallic mercury when heated with the carbonate of soda. 8. It is decomposed by a solution of protochloride of tin, and reduced to metallic mercury. In some of these characters it resembles corrosive sublimate, but it is eminently distinguished from that body by the first, third, and fourth. In addition to these differences, calomel is turned black by solution of ammonia, while corrosive sublimate forms a white compound. In order to detect its chlorine, it is necessary to boil a portion in a solution of potash, filter, and add to the filtered liquid, neutralised by nitric acid, nitrate of silver.

White precipitate. (Ammonio-chloride of mercury.)—This is an irritant compound, although but little is known concerning its effects. In January, 1840, a young woman was received into St. Thomas's Hospital, who had swallowed this substance, having mixed it up and taken it with water,—the quantity taken could not be ascertained. The stomach-pump was employed, mucilaginous drinks and olive-oil were administered; and in the course of a few days she perfectly recovered. The symptoms under which she suffered were those of gastric irritation. Judging from this case, white precipitate does not appear to be a very active preparation.

Chemical analysis.—This powder resembles corrosive sublimate in being entirely volatilized by a moderate heat, and in giving a metallic sublimate with dried carbonate of soda, but it differs in being insoluble in water. By heating it with solution of potash, ammonia is evolved, chloride of potassium formed, whereby the chlorine may be detected, and yellow peroxide of mercury, after long boiling, is left, which may be easily analyzed in the way already described.

Red precipitate. (Red oxide of mercury.)—This is a poisonous substance commonly met with in crystalline scales of various shades of colour, from a dusky to a bright red, and forming an orange-coloured powder. It is poisonous, but instances of poisoning by it are very rare. The following case occurred in Guy's Hospital in 1833. A woman, aged twenty-two, who had swallowed a quantity of red precipitate, was brought in labouring under the following symptoms. The surface was cold and clammy,—there was stupor approaching to narcotism,—frothy discharge from the mouth, and occasional vomiting—the vomited matters containing some red powder, which was proved to be red precipitate. There was considerable pain in the abdomen, increased by pressure; and there were cramps in the lower extremities. On the following day the fauces and mouth became painful, and the woman complained of a coppery taste. The treatment consisted in the use of the stomach-pump, and the administration of albumen and gluten. She left the hospital four days afterwards still under the influence of mercury. The quantity of oxide here taken was not ascertained.

Sobernheim reports a case, where a man, aged twenty-six, swallowed an ounce of red precipitate. He was speedily attacked by pain in the abdomen, nausea, purging, cramps and general weakness. The vomited matters consisted of masses of mucus, containing red precipitate. He continued to get worse, and died in less than forty-eigh hours after taking the poison. On inspection, the mucous membrane was found eroded and inflamed in patches, small particles of the poison being imbedded in it. The duodenum was in a similar state, and there was a large quantity of red precipitate in the contents of this viscus, as well as in the stomach. (Op. cit. 250.)

Notwithstanding the fatal result in this case, red precipitate does not appear to be a very active poison. Thirty grains of it have been taken and retained in the system, with comparative impunity. Some years ago a young woman swallowed this quantity, with a suicidal intention. Almost immediately afterwards, emetics of ipecacuanha and sulphate of zinc were administered, and the stomach-pump was used repeatedly; but none of the red powder was ejected. She suffered chiefly from pain in the abdomen and general weakness, but in the course of a few days she recovered. Devergie relates another instance of recovery in which a much larger dose had probably been taken. (Méd. Lég. ii. 705.)

CHEMICAL ANALYSIS.—Red precipitate is known,—1. By its being in red crystalline scales. 2. By its insolubility in water,—this, together with its great weight, renders it easy of separation from organic liquids. 3. It is readily dissolved by warm muriatic acid, forming a solution possessing all the properties of corrosive sublimate. 4. When heated in a small tube, it becomes black, (reacquiring its red colour on cooling,) and an abundant sublimate of metallic mercury is formed, oxygen gas being evolved. If the heat be continued, it should be entirely dissipated when pure,—a property by which it is known from most other red powders. In this experiment a slight yellow sublimate is sometimes formed (subnitrate) owing to the oxide retaining some traces of nitric acid.

TURBITH MINERAL. (SUBSULPHATE OF PEROXIDE OF MERCURY.)—This is an irritant poison, and has caused death. One fatal case is reported to have occurred in 1837-8, but the particulars are unknown.

CHEMICAL ANALYSIS.—Turbith mineral is a heavy powder of a yellow colour, becoming of a dark olive by exposure to light. It is scarcely soluble in water, but has a strong metallic taste. When heated in a tube, with or without carbonate of soda, it yields metallic mercury. It is best analyzed by boiling it in potash, in which case sulphate of potash and peroxide of mercury result—the acid and the base are then easily determined.

CINNABAR. VERMILION. (PERSULPHURET OF MERCURY.)—The term cinnabar is applied to a dark red heavy compound of sulphur and mercury, while vermilion is the same substance reduced to a fine powder. It is well known as a pigment, and is often employed in colouring confectionary, wafers, &c. I have not been able to find any instance of its having acted as a poison in man. It has, however, proved fatal to animals in the proportion of from thirty to seventy grains, even when applied externally to a wound.

CHEMICAL ANALYSIS.—Vermilion is of a rich red colour, very heavy, and quite insoluble in water. When dropped into the hydrosulphuret of ammonia its colour remains unchanged; while red precipitate and red lead are turned of a dark brown colour, or even black. It is also known from red precipitate by its insolubility in muriatic acid. 1. When heated on platina it is entirely volatilized, the sulphur burning away. 2. Heated in a reduction tube with carbonate of soda, a sublimate of metallic mercury is obtained with sulphuret of sodium, in which sulphur may be easily proved to exist by the usual tests.

Bicyanide of mercury. — This is a substance but very little known, except to chemists, yet it is an active poison, and has caused death in one instance. In April, 1823, a person who had swallowed twenty-three grains and a half of this compound, was immediately seized with all the symptoms of poisoning by corrosive sublimate, and died in nine days. There was continued vomiting, excessive salivation, ulceration of the mouth and fauces, suppression of urine, purging, and, lastly, convulsions of the extremities. On inspection, the mucous membrane of the stomach and intestinal canal, was extensively inflamed. As a poison, the bicyanide is probably not much inferior in activity to the bichloride of mercury.

Chemical analysis.—This is a white salt commonly crystallized in quadrangular prisms. It is very soluble in water, especially at the boiling point. Its solution is neutral, and is not precipitated by caustic potash. 1. If the powdered crystals be heated in a small tube, cyanogen gas is evolved and may be burnt at the mouth, the flame being of a rich purple colour, with a halo of blue; metallic mercury is at the same time sublimed. This is sufficient to identify this poison.

The solution of bicyanide is not unlikely to be mistaken for that of corrosive sublimate. It readily deposits mercury on copper and gold by the galvanic test, and it is precipitated black by hydrosulphuret of ammonia and sulphuretted hydrogen gas. It is further known, 1. By potash giving no precipitate; 2. By prussic acid being evolved on boiling a portion with muriatic acid, corrosive sublimate being produced in the liquid; 3. By a scarlet precipitate being formed on adding to the solution iodide of potassium and muriatic acid.

Nitrates of mercury.—These are corrosive poisons which are used for several purposes in the arts. They are solid white salts, easily dissolved by water, especially if there be a little excess of acid present. The acid pernitrate has already caused death in an interesting case reported by Mr. Bigsley in the Medical Gazette (vi. 329.) A butcher's boy dissolved some mercury in strong nitric acid, and swallowed about a teaspoonful of the solution. Soon afterwards he suffered the most excruciating pain in the pharynx, œsophagus and stomach:—there was great anxiety, with cold skin, small pulse, colic and purging. He became gradually weaker, and died in about two hours and a half. On inspection, the fauces, œsophagus and stomach were found corroded and inflamed. Although he survived so short a time, the mucous membrane of the stomach was of a deep red colour.

The acid pernitrate has been used as a cautery, and also when diluted, as a lotion in diseases of the skin. Under these circumstances it has been known to cause severe salivation, sloughing, and suppression of urine. A medical practitioner in France, was lately charged with malapraxis, in having improperly prescribed this solution, as a wash for the itch. The skin of the body where the lotion had been employed, was discoloured and partially corroded; there was also pain in the throat, difficulty of swallowing, inflamed gums and salivation. The parties recovered from these effects in the course of a short time.

and the charge was dismissed on the ground, that the lotion had been improperly used by the complainants; they had used it in a concentrated state, instead of diluting it with water as ordered by their medical attendant. (Ann. D'Hyg., Juillet, 1842.) There can be no doubt, that this poison is quite as formidable, both as a corrosive and irritant, as corrosive sublimate itself.

Chemical analysis.—In the solid state, the crystals of acid pernitrate, when heated in a tube, yield nitrous acid vapour,—peroxide of mercury, and a ring of metallic mercury,—when heated with carbonate of soda, metallic mercury is easily obtained. In *solution*, it is commonly met with in the state of a highly acid liquid, and nitric acid may be obtained on distillation, a result which does not occur with a mere solution of crystals in water. The solution possesses all the properties of that of corrosive sublimate, so far as the tests for mercury are concerned; but it gives no precipitate with nitrate of silver. On adding carbonate of potash and filtering, nitrate of potash is easily detected in the filtered liquid, and thus is the acid identified. On evaporating to dryness, and obtaining the solid crystals, they may be easily known from those of corrosive sublimato, by the simple application of heat.

The protonitrate is known in solution, both from pernitrate and corrosive sublimate, in its being precipitated black by potash, and white by muriatic acid. This acid does not precipitate the solutions of either of the salts above mentioned.

The acetate is another soluble salt of mercury, but nothing is known respecting it as a poison.

CHAPTER XIX.

ON POISONING BY LEAD AND ITS COMPOUNDS.

The metal lead is not commonly regarded as poisonous, but it is readily susceptible, by exposure to air and moisture, of being converted to a poisonous salt, the carbonate of lead. Many of its compounds are also much used in the arts, and have, on several occasions, given rise to serious accidents.

Dr. Bryce has lately reported an interesting case, from which it would seem that lead is capable of exerting a poisonous action even in the metallic state. A man aged twenty-three, swallowed three ounces of small shot (No. 4), in three days. On the third day there was great anxiety and depression, with sunken features, coldness of surface, dizziness and numbness in the arms and legs. He continued getting worse in spite of treatment; his bowels were obstinately torpid, and there was increased numbness in the arms and dizziness. Purgatives were exhibited; the alvine discharges examined, but only one pellet was found, so that if he passed the shot at all, it must have happened in the three days before he was seen by Dr. Bryce. This man perfectly recovered in a fortnight. (Lancet, Dec. 31, 1842.)

Shot are known to be formed principally of lead, with some small portion of arsenic in the state of arsenuriet or arseniate of lead. The quantity of arsenic is probably less than the 200th part of the weight of the shot; but the symptoms appear to show, that the effects were due to lead, and not to arsenic; the metal was probably oxidized and converted to an organic compound of lead, by the acid mucous secretions of the stomach. This case justifies the opinion that metallic lead cannot be strictly regarded as inert, or, if inert as a metal, it is susceptible of becoming transformed to a poisonous salt.

The only compounds of lead which have been found to produce poisonous effects upon the system, are the acetate, subacetate, chloride, carbonate, and the oxide of the metal combined either with vegetable acids or fatty substances. Dr. A. T. Thompson has expressed an opinion that the carbonate of lead is the only poisonous salt of this metal; and that, if any other salt become poisonous, it is by its conversion to carbonate in the body. His experiments, which were wholly negative with regard to dogs, do not appear to me to justify this view; but as that gentleman admits that the acetate and subacetate may act as poisons in large doses, and no toxicologist maintains that they are poisons when taken in small quantity, the difference of opinion is more verbal than real. (See Med. Gaz. x. 689.) So far as observations on man have yet extended, the carbonate has no more action than the common acetate. Dr. C. G. Mitscherlich has lately proved, that the acetate of lead is a poisonous salt; and that when mixed with acetic acid, it is more energetic than when given in the neutral state. This fact clearly shows that the poisonous effects cannot solely depend on the assumed conversion of the salt to the state of carbonate. (Brit. and For. Med. Rev. No. vii. 208.)

Sugar of lead. (Acetate of lead.) This is more frequently taken as a poison than any other salt, although cases of acute poisoning by lead in any form are very uncommon. In the coroner's report for 1837-8, there is not a single case. This substance is commonly seen in solid crystalline masses, white or of a brownish-white colour; it much resembles loaf-sugar in appearance, and has often been mistaken for it. It has also a sweet taste, which is succeeded by an astringent or metallic taste. It is very soluble in water. Four parts of water at 60° will dissolve one part; and it is much more soluble at a boiling temperature.

Symptoms.—Acetate of lead is by no means an active poison. In medical practice, it has often been given in considerable doses without any serious effects resulting. When, however, the quantity taken has been from one to two ounces, then the following symptoms have been observed. A burning pricking sensation in the throat, with dryness and thirst. Vomiting supervenes; there is uneasiness in the epigastrium, which is sometimes followed by violent colic. The abdomen is tense, and the parietes have been occasionally drawn in. The pain is relieved by pressure, and has intermissions. There is constipation of the bowels. The skin is cold, and there is great prostration of strength. When the case is protracted, the patient has been observed to suffer from cramps in the calves of the legs, pain in the insides of the thighs, numbness and sometimes paralysis of the extremities. The affection of the nervous system is otherwise indicated by giddiness, torpor, and even coma.

Post-mortem appearances.—I have not been able to find more than one case on record in which acetate of lead has proved fatal to man, and there is no account of the post-mortem appearances. In animals, according to Dr. Mitscherlich, when the dose is large, the mucous coat of the stomach is attacked and corroded; this change appears to be purely chemical, and takes place in all the organs of the body with which the salt of lead comes in contact. If given in a small dose, it is decomposed by the gastric secretions, and exerts no corrosive power on the mucous membrane. When the acetate of lead was given in a state of albuminate dissolved by acetic acid, death took place with great rapidity; but on inspection the stomach was not found to be corroded. This property belongs to the neutral salt, and is not manifested when the dose is small, or when the poison is combined with an acid.

Treatment.—This consists in the free exhibition of solutions of the alkaline sulphates, either of soda or magnesia. The carbonates should be avoided, as the carbonate of lead is poisonous; while the sulphate is either inert or possesses but very little activity. An emetic of sulphate of zinc should be given if vomiting does not already exist. The stomach-pump may be occasionally employed with benefit. It is well known that albumen precipitates the oxide of lead when added in large quantity; and Mitscherlich has found that casein, the albuminous principle of milk, is a very effectual precipitant of the oxide of lead. Therefore it would be advisable to administer, in cases of poisoning by the soluble salts of lead, milk or albumen in large quantity. The compounds thus formed, as in the case of corrosive sublimate, may not be absolutely inert; but they are far less active than the acetate itself, and tend to prevent the action of the poison as a corrosive on the stomach.

Four cases are on record where individuals have recovered partly through treatment, after having swallowed one ounce of the acetate of lead.

Mr. Iliff met with an instance where an ounce was swallowed in solution. The symptoms were pains in the abdomen resembling colic, vomiting, rigidity and numbness. It was three hours before any remedies were used, and five hours before the stomach-pump was employed, but the person recovered.

In the second case an ounce was swallowed; sulphate of magnesia was freely exhibited, and the stomach-pump was used. On the following morning there was slight excoriation of the gums which were white, with a sensation of heat in the throat; the bowels were relaxed, probably from the effect of the medicine. The day following, there were pains in the calves of the legs and thighs with restlessness and thirst. In a week, the woman perfectly recovered.

In October, 1835, a girl, aged nineteen, dissolved about an ounce of acetate of lead in a cupful of water, and swallowed it. In a quarter of an hour violent vomiting came on, and she was taken to the North London Hospital. Sulphate of magnesia and dilute sulphuric acid were given to her; there was slight pain in the abdomen, weight in the head, dimness of sight and pains shooting through the eyeballs. The abdomen was tender on pressure for several days; but in five days the patient was discharged cured.

The fourth case occurred in Paris, in 1840. A girl swallowed an ounce of the acetate of lead: the usual symptoms followed, and sulphate of soda was administered. She recovered.

GOULARD'S EXTRACT OF LEAD. (SUBACETATE. TRIACETATE OF LEAD.)

Goulard's extract is generally seen under the form of a yellowish coloured liquid, as it is often made with common vinegar instead of acetic acid. This substance has caused death in at least four instances,—one in France and three in England. The symptoms produced are similar to those described in speaking of the former compound. The subacetate is much more powerful as a poison, than the neutral acetate, probably from its containing a larger quantity of the oxide of lead.

One fatal case of poisoning by Goulard's extract is marked down in the coroner's return for 1837-8; in January, 1840, two other cases of poisoning by it occurred in this city in two children, aged respectively four and six years. The quantity taken by the children could not have been very great, but they both died within thirty-six hours. The symptoms were at first violent vomiting and purging;—in one case they resembled those of Asiatic cholera. The bodies were inspected by Dr. Bird, and presented the following appearances. The mucous membrane of the stomach was of a grey colour but otherwise perfectly healthy. The intestines were found much contracted, in one instance more so than in the other. On the other hand, Mr. Marshall mentions a case of recovery where two fluid ounces of Goulard's extract had been taken by mistake. (On Arsenic, 106.)

There is a case reported in most foreign works on toxicology, where an inspection was made of the body of a man who had been killed by taking a quantity of Goulard's extract. He died within forty-eight hours; and there was well-marked inflammation of the alimentary canal from the œsophagus downwards. The villous coat of the stomach was completely softened, and the effused mucus was found to contain the poison.

It has been a question, whether in cases of poisoning by acetate of lead, the metal is absorbed and enters into the circulation. It is said to have been found by Tiedemann in the blood of animals poisoned by it. Orfila also detected lead in the urine of a female who swallowed an ounce of the acetate; but Dr. Mitscherlich was unable to find any traces of the metal in the blood or urine of poisoned animals.

CHEMICAL ANALYSIS.—Acetate of lead as a *solid*. 1. If a portion of the powder be heated in a small reduction-tube, it melts, then becomes solid; again melts, acquiring a dark colour, and giving off vapours of acetic acid;—

a black mass is left in the tube, consisting of carbon and reduced metallic lead. There is no sublimate formed. 2. It is very soluble in water, even when cold; common water is turned milky by it chiefly from the presence of carbonic acid and sulphates. 3. A small portion of the powder dropped into a saucer, containing a solution of iodide of potassium, acquires a fine yellow colour. 4. When dropped into caustic potash, it remains white;—5. into hydro-sulphuret of ammonia it is turned black, in which respect it resembles the white salts of some other metals. 6. When the powder is boiled in a tube with diluted sulphuric acid, acetic acid, known by its odour and volatility, escapes.

All these properties, taken together, prove that the salt is acetate of lead.

Tests for the *solution*. If acetate of lead be presented in the state of solution, or if the solid salt be dissolved in water for the purpose of making further examination, we should note the following points. 1. A small quantity slowly evaporated on a slip of glass, will give opake prismatic crystals, which are turned yellow by iodide of potassium, and black by hydro-sulphuret of ammonia. The solution is said to be neutral; but I have found the common acetate of lead to have at the same time both an acid and alkaline reaction, i. e. reddening litmus paper, and turning rose paper green, a circumstance which might create some embarrassment in an analysis. 2. Caustic potash, added to the solution much diluted with water, throws down a white precipitate, which is soluble in an excess of the alkali. 3. Diluted sulphuric acid produces an abundant white precipitate, also soluble in a large excess of caustic potash. 4. It is precipitated of a bright yellow colour by the iodide of potassium; the yellow iodide of lead is also soluble in caustic potash, forming a colourless solution. 5. Hydrosulphuret of ammonia or sulphuretted hydrogen gas, produces a deep black precipitate, even when not more than the 100,000th part of salt is dissolved. 6. Place a few drops of the solution on clean platina foil,—acidulate it with acetic acid, then apply, through the solution to the surface of the platina, a thin polished slip of zinc:—bright crystals of metallic lead are instantly deposited on the zinc: in this way a very small quantity of lead may be detected. 7. If a slip of zinc foil with a little acetic acid be introduced into the solution, there speedily takes place a deposit of metallic lead on the surface of the zinc.

Objections to the tests.—It must be understood that these tests should be taken together, as the objection to any one is thus counteracted by the application of the others. With regard to potash this gives a similar precipitate with the salts of barytes, strontia, lime and magnesia; but none of these precipitates are soluble in an excess of the alkalies. Potash also precipitates alum and sulphate of zinc; and these precipitates, like that from lead, are soluble in an excess of caustic alkali, but the solutions of alum and zinc are not precipitated by sulphuric acid. Sulphuric acid gives a white precipitate with some other compounds; but these are known from sulphate of lead, by their insolubility in caustic potash. The action of iodide of potassium is peculiar. There are several objections to the fourth test; for the salts of mercury, silver, copper, cobalt, nickel, bismuth and the protoxides of iron and tin, are precipitated by hydrosulphuret of ammonia, either of a black or dark brown colour. Some of the solutions of these salts are known by specific properties,—those of copper, cobalt and nickel are coloured;—the solution of bismuth is decomposed and precipitated by water, while the salts of these metals do not give results similar to those of lead with the other tests, nor can lead be extracted from them by the galvanic or any other process.

The operator should be aware, that lead may be contained in many alkaline or saline liquids when they have been long kept in flint-glass bottles. Thus, solutions of potash and soda, as well as of their respective carbonates, become so strongly impregnated with lead, after having been kept a few weeks in flint-glass, as to be turned of a dark brown colour, or even black, on the addition of hydrosulphuret of ammonia. I have found so much lead in a solution of caustic soda, that it was precipitated by sulphuric acid. That the lead was derived from this source, was clearly proved by the fact, that the solutions, before being placed in flint glass, were not affected by the hydrosulphuret. It is said that the alkaline chlorides and phosphates, as well as the mineral acids, will also dissolve the oxide of lead under these circumstances; but I have not found this to be the case. These facts should be borne in mind when liquids are examined which are suspected to have been intentionally poisoned. The quantity of oxide of lead thus dissolved, is not sufficient to produce mischief; but its presence might lead to an erroneous opinion and embarrass the analysis.

It is important to mention that all the precipitates of lead which are redissolved by caustic potash, are thrown down black by adding hydrosulphuret of ammonia to the respective alkaline solutions. This enables the operator to apply two or three tests to one portion of suspected liquid.

In organic mixture.—The acetate of lead is precipitated by many organic principles, especially by albumen and tannin. Thus, we may have to analyse either an organic liquid containing lead, or a solid precipitate consisting of mucus or mucous membrane, intimately united to the oxide of lead. We must filter and examine the liquid by a trial test. This experiment may be performed either by adding to a portion, sulphuric acid, or by exposing bibulous paper dipped into the suspected liquid to a free current of sulphuretted hydrogen. If the paper is not stained brown, there is no perceptible quantity of lead dissolved;—if it is stained brown, we dilute the liquid if necessary to destroy its viscidity, and pass into it a current of sulphuretted hydrogen until all action has ceased. The black sulphuret of lead should be collected on a filter, washed and dried, then boiled for a quarter of an hour in a mixture of one part of nitric acid, diluted with four parts of water. This has the effect of transforming it, at least in part, to nitrate of lead soluble in water. This liquid, when filtered, may be cautiously neutralized by potash or ammonia, and the tests added. If the quantity be too small for the application of all the tests, we may add sulphuric acid;—if a white precipitate be formed, soluble in potash, and this solution again turned black by hydrosulphuret of ammonia, this is sufficient evidence of the presence of lead.

If there be no lead dissolved, we must digest the solid and insoluble matters in nitric acid slightly diluted, at a boiling temperature, filter and test the filtered liquid, previously neutralized.

If no result be obtained by either of these processes, it will be necessary to cut the stomach or any other suspected solids to pieces; and after having dried them thoroughly, to incinerate them with four parts of black flux in a crucible. If lead be present, it will be found at the bottom of the crucible in the form of a metallic button, and the carbonaceous matters may be separated by washing the residue in water. The nature of the acid united to the lead, cannot of course be determined in such a case; but this would be unimportant to the inquiry, as all the salts of lead are poisonous, excepting perhaps the sulphate. It may be objected that lead is naturally contained in the animal tissues:—this is somewhat doubtful, but admitting it to be true, the metal exists only in infinitesimal traces, whereas in a case of poisoning, it is likely, if obtained at all, to be obtained in pretty large quantity. In poisoning by the subacetate, traces of lead have been found in the stomach three days after death; and there is no doubt, that it might be detected after many months had elapsed.

Goulard's extract.—This cannot be readily procured in a solid or crystalline state;—the solution in water is strongly alkaline, there being a much larger quantity of oxide of lead than in the common acetate. It possesses the reactions of that salt, but differs from it in being copiously precipitated by a solution of gum acacia.

Nitrate of lead.—This salt is commonly seen in solid tetrahedral crystals:—when powdered and heated in a reduction tube, it gives off nitrous acid vapour, and yellow protoxide of lead is left. It is readily dissolved by water; the solution is neutral and is not precipitated by tartaric acid, which distinguishes it from the two preceding salts. The nature of its acid is best determined by adding carbonate of potash to the solution,—and filtering:—the filtered liquid should on evaporation yield nitrate of potash. All the tests for lead mentioned in speaking of the acetate, apply equally to this salt.

CHLORIDE OF LEAD.—Some years since a woman was brought to Guy's Hospital, who had swallowed the chloride of lead: the quantity could not be ascertained, but a portion of the poison was found in the paper, out of which she had taken it. There were no urgent symptoms except vomiting: alkaline sulphates were exhibited, but she suffered so little inconvenience, that she left the hospital the same day and eventually did well.

CHEMICAL ANALYSIS.—This is a white pulverulent salt: when heated in a tube it fuses into a yellowish green mass and remains fixed—it is soluble in hot, but not very soluble in cold water:—the solution gives the reactions indicated with the tests for lead; and the chlorine may be discovered by nitrate of silver. This salt is rendered more soluble in water by nitric or muriatic acid:—it is insoluble in alcohol.

TURNER'S YELLOW. (OXYCHLORIDE OF LEAD).—This is commonly seen in the form of a fine yellow coloured powder; it is sometimes called mineral yellow. Its action on the body is unknown; but it is much used in the arts, and as it might be mistaken for another substance, its chemical properties require a brief description.

It is a very fusible substance, it melts when heated and remains fixed, it is partially soluble in caustic alkalies:—when digested in nitric acid, oxide of lead is dissolved and a milky white chloride of the metal remains.

CARBONATE OF LEAD. (WHITE LEAD. CERUSE.)—This substance is extensively used in the arts. It is commonly seen in the form of heavy white masses resembling chalk. It is insoluble in water, but still possesses poisonous properties, a decided proof, among numerous other facts, that insolubility does not prevent a substance from exerting a poisonous action on the system. The very small quantity of free acid contained in the gastric secretions, may dissolve a portion; but the quantity of carbonate required to neutralize the free acid in the stomach, would probably produce no serious symptoms whatever; since we find it is only in very large doses that this substance acts as an irritant poison. I have not been able to meet with more than one fatal case of poisoning by the carbonate of lead in the human subject; but there are numerous instances of its having proved insidiously fatal, by inducing colica pictonum; these, however, are cases of chronic poisoning, and are more interesting in a medical than in a medico-legal point of view. The following case of recovery from a large dose of carbonate of lead is reported by Mr. Cross.

A woman, aged thirty-three, took by mistake for a dose of magnesia, from six to eight drachms of carbonate of lead. Five hours afterwards, she was seen by her medical attendant: she was in a cold perspiration breathing heavily, constantly vomiting, her pulse hard, small, and quick. There was great anxiety of countenance, with dryness of the throat;—a sense of heat in the stomach, with very painful colics. Castor-oil and sulphate of magnesia, with diluted sulphuric acid, were given to her ,—the last at frequent intervals. The extensor muscles became paralysed, and the flexors rigidly contracted,—the colics were so excruciating, that the patient generally fainted after each paroxysm. The evacuations from the bowels were of a very dark colour, probably from the action of sulphuretted hydrogen contained in the intestines upon the lead. The symptoms abated, but the next day there were nausea and faintness with griping pains. In four days she was convalescent. This case shows that the carbonate of lead, although poisonous, is not very energetic. Its action as a poison is probably not greater than that of the acetate; and so far as observations on the human subject extend, it is less active than the subacetate.

In respect to *treatment*, it is obvious that the alkaline sulphates could not here be employed as antidotes, since it requires long digestion at a high temperature, for these salts to react on the carbonate of lead, and even then the decomposition is only partial. I would suggest, in a case of this kind, the expediency of administering an alkaline sulphate mixed with vinegar or some weak vegetable acid, such as lemon-juice. Emetics and the stomach-pump should also be employed.

Painter's colic may be regarded as the chronic form of poisoning by carbonate of lead. The carbonate finds its way into the system, in the case of white lead manufacturers, either through the skin or through the lungs, or both together;—it becomes diffused in a fine powder through the atmosphere, and thus enters into the lungs. It has been remarked in France, that in manufactories, where the powder was ground dry, not only have the labourers suffered, but also horses, dogs and even rats, have died from its effects. Since the practice has arisen of grinding the carbonate in water, cases of colica pictonum have not been so numerous. They are still, however, frequent among painters, the manufacturers of glazed cards, and among those engaged in the glazing of pottery, where oxide of lead is employed.

The diagnostic symptoms of this disease are well marked. One of a peculiar nature has been lately pointed out by Dr. Burton, namely, a blueness of the edges of the gums, where these join the bodies of the teeth. The disease often kills the patient; and after death, the intestines are found contracted, especially the colon. No traces of lead have ever been discovered in any of the secretions, excretious, or soft organs of the bodies of those who have died from painter's colic. M. Grisolle made numerous analyses of the fluids and viscera in fatal cases, without detecting any traces of the metal. The urine of workmen employed in white lead manufactories has been repeatedly examined, but no lead has been discovered in it. This is owing probably to the very small quantity absorbed, since the tests for lead are remarkably delicate, and would detect it, were it in no larger proportion than the 200,000th part of the liquid examined.

A few years since a cow drank up a large quantity of paint, of which carbonate of lead was the chief ingredient. The animal suffered severely;—sulphate of soda was largely exhibited, and the cow eventually recovered. While the animal was labouring under the effects of the poison, a quart of milk was drawn from it, put into a glass bottle, and sent to me for examination. I found that sulphuretted hydrogen gas gave with it a minute black flaky precipitate, which appeared to be sulphuret of lead. I tried several other specimens of milk, obtained in the usual way from London dealers, without finding that they were in the least affected by a current of sulphuretted hydrogen gas. (See Guy's Hosp. Rep. No. 12.) This result seems to show that in poisoning by white lead, the metal is taken up in some form and excreted. This, however, was an acute case of poisoning, a fact which may explain the difference in the analytical results.

One other form of poisoning by carbonate of lead is of some interest to the medical jurist,—I allude to the impregnation of water with this substance by contact with metallic lead. This metal, it is well known, is largely used for water-cisterns and pipes; and, under certain circumstances, carbonate of lead is apt to be formed in large quantity, and to be diffused in the water. It has been supposed that carbonic acid in the water would partially dissolve, and suspend the carbonate in it, but in saturating water with carbonic acid over finely divided carbonate of lead, it was not found on filtration that any portion had been dissolved. This change is chiefly observed in respect to new lead, or the metal which has a bright and polished surface. Old lead does not easily produce the carbonate, the metal being protected by the crust already formed on it and firmly adhering to it. When water thus impregnated with carbonate of lead is used, symptoms of poisoning may suddenly affect a whole family, without the cause being at first apparent; or one or more cases of chronic poisoning by lead, may unexpectedly show themselves among the members of a household where such water is used.

This subject has been most fully examined by Dr. Christison. I have repeated his experiments, and made some others, the results of which will be found elsewhere. (Guy's Hosp. Rep. No. 6.) The conclusions at which I have arrived, coincide nearly with those obtained by Dr. Christison.

There are two kinds of water liable to become poisoned, when kept in contact with lead under a free access of air. 1. That which abounds in carbonic acid; 2, that which contains little or no saline matter. Of this last we have instances in distilled water, rain water, or remarkably soft water. With respect to highly carbonated water, this may be known by boiling a portion in a flask or retort, and conducting the gaseous products into a solution of subacetate of lead. Lime-water will also serve as a test, although it is not so delicate. The second kind of water is known by evaporating at least a gallon to dryness, and noting the weight of *soluble* saline matter obtained. If this form less than the 15,000th part of the weight of the water, it is liable to acquire an impregnation from lead. The Thames water contains about the 7000th of its weight of saline matter; and I have kept in this water for five years a mass of lead, exposing fifty-eight square inches of surface, without any carbonate being produced. As the water was slowly lost by evaporation, the quantity was made up. Distilled water, treated in like manner during the same period, has produced a very considerable quantity of carbonate of lead. I have found that a mixture of equal parts of river and distilled water had no action on lead, consequently a preservative effect existed where the proportion of saline matter could not have been more than the 14,000th part. The Edinburgh water, according to Dr. Christison, contains about the 12,000th of its weight of saline matter; and it has but a feeble action on lead.

That used at Tunbridge some years since contained only the 38,000th part, a quantity so small, that with a knowledge of these facts, it is not surprising it should have become contaminated with lead, and given rise to lead colic among the inhabitants.

This chemical production of carbonate of lead takes place with extreme rapidity. On putting a fresh-scraped piece of the metal into about three ounces of distilled water, I have observed a milky film to be formed around it, in the clear sunshine of summer, in the course of a few minutes; and in twenty-four hours a thick crystalline sediment of carbonate of lead was deposited. Rain water collected directly from the atmosphere, had the same property: but that which had passed over roofs of slate or tile, was more slowly, and in some instances not at all affected. This production of carbonate by contact with bright lead, is one of the best tests of the absolute purity of distilled water; and conversely this experiment is the best that can be suggested, for determining whether any particular kind of water is liable to acquire a poisonous impregnation from that source. If the fresh metallic surface remain bright after twenty-four hours, or only acquire a faint incrustation of sulphate;—and hydrosulphuret of ammonia does not give a brown tint to the water, there is but little danger of its becoming poisoned with lead.

My experiments have led me to the conclusion, that sulphate of lime is the salt which, by its presence in most kinds of hard water, prevents this action on lead. When this salt forms only the 5,000th part of the weight of water, no carbonate of lead is formed;—and the sulphate of lime, dissolved in this or in a larger proportion in distilled water, will confer on it the properties possessed by river water. Sulphate of lead appears to be slowly formed; this closely invests the metal, and prevents the production of any loose crystalline carbonate. Thus then a water, which is abundantly precipitated by a salt of barytes, and by oxalate of ammonia, is, cæteris paribus, not very likely to give rise to lead colic by passing through lead pipes, or being preserved in leaden cisterns.

Chemical analysis.—Carbonate of lead is a solid white powder, insoluble in water, and immediately blackened by sulphuretted hydrogen or hydrosulphuret of ammonia. 1. When heated on platina, it leaves a residue of yellow or orange-coloured oxide of lead, soluble in acids. 2. The carbonate is easily dissolved by diluted nitric acid with effervescence, which shows that it contains carbonic acid. The oxide of lead, combined with nitric acid, may be easily detected by the tests already mentioned. If the carbonate be mixed with sulphate of lead or sulphate of barytes, those bodies will remain undissolved by nitric acid. This salt may be easily reduced on charcoal by the blow-pipe and metallic lead procured.

Sulphate of lead.—This, owing to its great insolubility, is considered not to be a poisonous salt; but it is by no means certain that large doses of it could be taken with impunity. It is, perhaps, not more insoluble than carbonate of lead, calomel, or Scheele's green; and yet these are known to act on the body. There is, however, good reason to believe that its action, if any, is considerably less than that of the other salts of the metal; and on this fact, the antidotal treatment of lead-poisoning by alkaline sulphates, is based.

In a case of poisoning, owing to the administration of antidotes, this salt of lead may be found in the stomach, scattered in white masses over the mucous membrane. Being very heavy, it will not be difficult to separate it by decantation; and, as it is quite insoluble in water and acids, it will be proper to describe the method of determining its nature.

Chemical analysis.—Sulphate of lead is a white solid, resembling the carbonate by its insolubility in water, but differing from it in not being soluble in acids. 1. When dropped into the hydrosulphuret of ammonia, it is blackened; and thus is it known from the sulphate of barytes, which it otherwise resembles. 2. When heated on platina foil, it remains unchanged, or becomes only slightly darkened, if any organic matter be mixed with it or the flame of the lamp come in contact with it. 3. When suspended in water, and a current of sulphuretted hydrogen is passed through it,—black sulphuret of lead is precipitated, (for the analysis of which, see anté, p. 189,) and sulphuric acid is dissolved by the water, in which, after evaporation to get rid of the sulphuretted hydrogen gas, it may be detected by the appropriate test, namely, a salt of barytes.

Oxides of lead.—The yellow oxide (massicot) and the brown oxide (peroxide) are but little known except to chemists. Litharge and minium are, however, much used in the arts, and have sometimes given rise to accidental poisoning. Liquids used for culinary or dietetic purposes, especially if they contain a free acid, are liable to become impregnated with oxide of lead, derived from the glaze of the vessel in which they are kept, and to form poisonous salts. If vinegar be used, acetate of lead may result. Litharge glaze is also easily dissolved by alkaline or fatty substances. The eating of dripping or fat of meat, baked in a newly glazed vessel, has thus been known to give rise to slight attacks of colic; while the symptoms were referred by the party to some substance mixed with the food. When articles of this kind are impregnated with oxide of lead, the fact is immediately known by their being turned more or less of a brown colour by hydrosulphuret of ammonia. Litharge was formerly much used to remove the acidity of sour wine, and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause. The adulteration was discovered by Fourcroy, and it was immediately suppressed. Such wine is known by its being blackened by hydrosulphuret of ammonia. Snuff has been found to be adulterated with red lead: in one instance this mixture is supposed to have caused death, and in another, it gave rise to alarming symptoms. (Med. Gaz. xxxii. 138.

It is well known that lead shot are much employed for the purpose of cleaning wine bottles, and that a number of pellets are frequently left in the bottles, whereby a question has arisen, whether wine introduced into them is liable to acquire a poisonous impregnation from lead. I have found that when the shot were in much larger proportion than could ever be left by accident in a wine bottle,—good wine, whether port or sherry, became slowly impregnated with lead. After two or three months, a white sediment had formed, but no lead was dissolved; after thirteen months, the port wine retained its colour, and scarcely any portion of lead was dissolved by it: the sherry had become darker in colour, and the presence of lead was very evident in it. It is now nearly four years since the experiment was commenced, and the port wine still has a dull red colour, and gives only faint traces of lead with hydrosulphuret of ammonia and sulphuretted hydrogen gas:—the sherry has now acquired a very pale straw colour, and is pretty strongly impregnated with lead. Thus, then, even under the most favourable circumstances, good wine is but slowly contaminated by contact with lead. Acid wines, such as those made from the currant or gooseberry, might, however, become much more rapidly impregnated with the metal, and in a quantity sufficient to produce colic or other serious symptoms.

Cyder is apt to become poisoned with the salts of lead when it comes in contact with that metal. It has been generally supposed that the only poisonous compound produced in this case is the insoluble malate; and it appears from an accident which occurred lately in France, where six persons were seized with symptoms of lead-poisoning from drinking cyder, that Chevallier and Ollivier discovered the poisonous salt to be the malate of lead. A large quantity of acid may probably suspend this and other vegetable salts which are reputed to be insoluble; or it may happen that, like the carbonate of lead in water, the insoluble salt may be diffused through the liquid, and suspended in an extreme state of division.

It has been found that sugar is sometimes the medium of conveying lead-poison into the system, and giving rise to attacks of colic in those who partake of it. Dr. Jackson has reported an instance of this kind, in which several persons lost their lives, and many others were attacked with paralysis and colic, who had partaken of sugar which had probably been kept in leaden reservoirs. Lead was discovered in the sugar in large quantity. (Med. Gaz. xvii. 1036.)

Chemical analysis.—Litharge is commonly seen in reddish or yellow-coloured scaly crystals, insoluble in water, but soluble in great part, or if pure, entirely in dilute nitric acid. The solution possesses all the characters of nitrate of lead. Minium or red lead is commonly seen as a rich orange-red powder;—it is partially dissolved by acids,—a portion of brown peroxide being left. The solution gives the usual reactions with the tests for lead. Both of these oxides are easily reduced on charcoal by the aid of a blow-pipe, or by mixing them with paste,—painting with this mixture a piece of card, drying it and burning it, metallic lead is immediately produced. Minium is known from vermilion among other properties, by its being blackened by hydrosulphuret of ammonia; from red oxide of mercury, by the action of nitric acid, as well as by the effect of heat. Red oxide of mercury is entirely dissipated into oxygen and mercury,—minium gives off oxygen, but remains fixed as an orange-yellow oxide of lead. It is a common colouring matter in red wafers.

Oxide of lead has been known to affect the system even when applied to the skin, and it is proper to state that most hair dyes are composed of a mixture of lime and oxide, or a subsalt of lead. The long continued use of these preparations may give rise to symptoms, for the origin of which a practitioner would not be able to account. Dr. Brück of Hanover observed that a violent ophthalmia was induced in a lady who had used for dyeing her hair, a substance called poudre d'Italie, which on chemical analysis was found to consist of lead and lime. Although these hair-dyes are much used in England, I have not heard of any ill effects following their employment.

QUANTITATIVE ANALYSIS.—This may perhaps be most conveniently effected by converting the salt of lead to sulphuret by passing into it, either suspended or dissolved in water or acids, a stream of sulphuretted hydrogen gas. The precipitate should be well washed, dried, and weighed. Every 100 parts of sulphuret are equal to 86.5 by weight of metallic lead; and from the known equivalents of the salts, the quantity of each may be respectively calculated. In some instances we may calculate from the quantity of sulphate of lead formed by adding an alkaline sulphate: 100 parts of sulphate are equal to 73·5 of protoxide of lead.

CHAPTER XX.

ON POISONING BY COPPER AND ITS COMPOUNDS.

COPPER itself is said to be destitute of poisonous properties; but it would appear that when alloyed with other metals and reduced to a finely pulverulent state, it may act as a poison. A singular instance of this kind occurred lately in London. The printing in gold, as it is termed, is performed by means of a copper alloy. The letters are printed with a mixture of size and gamboge; and the copper alloy, reduced to such a fine state of division that it floats in the atmosphere in an impalpable dust, is then brushed over the surface. A boy employed in this occupation was, on the third day, seized with vomiting of a green coloured fluid, heat and constriction in the œsophagus, pain in the stomach, loss of appetite and rest, and a severe itching in all those parts which were covered with hair. These on examination were found to be of a deep green colour. The boy soon recovered. About twelve other persons, employed in the same work, suffered from similar symptoms; but this did not prevent them from continuing the work. The poison in this case probably entered the system through the lungs and skin. This peculiar effect of finely divided copper in giving a green tint to those parts covered with hair, is mentioned by Dr. Falconer in his Essay on the Poison of Copper, (p. 42,) published in 1774.

SULPHATE OF COPPER.—All the salts of copper are poisonous. The two most commonly known are the SULPHATE (BLUE VITRIOL) and the SUBACETATE (VERDIGRIS). These substances have been frequently taken and administered in large doses for the purposes of suicide and in attempts at murder. In the latter case, the attempt has been immediately discovered, owing to the strong metallic taste possessed by the salt. This would in general render it impossible that the poison should be taken unknowingly. With the exception of these salts, poisoning by copper is generally the accidental result of the common use of this metal for culinary purposes.

SYMPTOMS.—Sulphate of copper has been frequently given for the purpose of procuring abortion. In doses of half an ounce and upwards it acts as a powerful irritant, and in very young children a much less quantity would suffice to kill. The salt speedily induces vomiting of the most violent kind; and this sometimes effectually expels the poison from the stomach, and the person recovers. The vomited matters are remarkable for being of a blue or green colour, and broken crystals of blue vitriol have been discovered in them, where the poison was taken in a loosely pulverulent state. There is pain in the abdomen, with diarrhea, and in aggravated cases, spasms of the extremities. Dr. Perceval met with a case where the most violent convulsions were produced in a young female by two drachms of the sulphate of copper;—she eventually recovered. Paralysis, insensibility and even tetanus, have preceded death, when the poison was administered to animals.

Among the symptoms casually met with in the human subject may be mentioned jaundice. This has been observed to attend poisoning by the sulphate, as well as by Scheele's green.

I have been able to find only one instance in which this poison has proved fatal in the human subject: it occurred in London in 1836. A girl sixteen months old, put some pieces of blue stone (sulphate of copper) which were given to her to play with, into her mouth. In a quarter of an hour, the child vomited a bluish green coloured matter with pieces of sulphate of copper in it; the skin was alternately cold and hot, but there was neither diarrhea nor convulsions. The child died in *four hours*, and was insensible before death. The coroner and jury did not consider it necessary that an inspection should be made, and yet in the event of murder being committed by the administration of this substance, it would be expected that the medical witnesses should be fully acquainted with the post-mortem appearances produced by it.

THE SUBACETATE OF COPPER (VERDIGRIS) produces somewhat similar symptoms. Vomiting of a green coloured liquid and diarrhea are the most prominent symptoms. In a case reported by Pyl, a woman who took two ounces of verdigris, died in three days:—in addition to the symptoms above described there were convulsions and paralysis before death. Niemann relates that a female, aged 24, swallowed half an ounce of verdigris, and died under symptoms of violent gastric irritation in sixty hours.

There is but little doubt that all the other salts of copper would act in a similar way. Experiments on animals show that they are irritant poisons.

POST-MORTEM APPEARANCES.—The mucous membrane of the stomach and intestines has been found more or less inflamed in the few fatal cases which have been examined,—the membrane has been found also eroded and softened in poisoning by verdigris. The œsophagus has presented an inflammatory appearance. The lining membrane of the alimentary canal is often throughout of a deep green colour, owing to the small particles of verdigris adhering to it. It has been said, that this is an uncertain character of poisoning by copper; since a morbid state of the bile often gives a similar colour to the mucous membrane of the stomach and duodenum. This objection cannot apply, where the green colour is also found in the œsophagus, and throughout the intestines: and, under any circumstances, the evidence from the presence of a green colour would amount to nothing in the judgment of a prudent witness, unless copper were freely detected in the parts so coloured.

Treatment.—In general there is violent vomiting,—the salts of copper acting powerfully as emetics. The efforts of the stomach should be promoted by the free exhibition of warm water, milk, or any mucilaginous drink, and the use of the stomach-pump. This latter instrument would be of little use, where the poison has been taken in coarse powder, as is generally the case. Various antidotes have been proposed. Sugar was formerly strongly recommended, on the principle that it had the property of reducing the salts of copper to the state of insoluble suboxide; but Vogel found, that this chemical effect was chiefly confined to the subacetate, and in order that it should take place it was necessary that the substances should be heated to 212°. M. Pastel has since asserted, that the same decomposition goes on between these substances at the temperature of the stomach, and even at the ordinary temperature (Annales d'Hyg. 1833:) he is therefore inclined to regard it still as an antidote, although it seems that animals to which he administered it, died; but not so rapidly as when the poison was allowed to act by itself. Albumen is well known to form an insoluble compound with oxide of copper, provided the albumen be in very large excess; for the albuminate of copper is easily dissolved by an excess of the solution of sulphate. How far this would act on the comparatively insoluble acetate, it is difficult to say; as also whether it be not itself a poison; still it may reduce the activity of the soluble salts of copper, and thus it would be advisable to administer it conjointly with the other means recommended. Dr. Edwards, some years since, recommended the use of iron filings for precipitating the copper; but the action in this case is too slow, and is immediately arrested by the iron becoming enveloped by a thin film of copper. If it even precipitated all the copper in the metallic state, sulphate of iron would be found in the stomach, and this is itself an irritant. The hydrated oxide of iron has been used in Germany in poisoning with arsenite of copper. A child swallowed a small quantity of green paint containing arsenite of copper: violent vomiting supervened with coldness of surface,—milk was given, and afterwards the hydrated oxide of iron. In five hours the vomiting had abated, and the child recovered. (Med. Gaz. xxxi. 270.) It does not appear to me that the recovery could here be ascribed to the effect of the supposed antidote. Even if arsenite of iron were formed by a reaction on the insoluble arsenite of copper, the former has been proved to be as poisonous as the latter.

CHEMICAL ANALYSIS.—The salts of copper are generally known by their colour: whether in the solid state or in solution, they are either blue or green;—the salts of one other metal are also of a green colour, namely, nickel; but there are striking chemical differences between the salts of this metal and those of copper. There are three very soluble salts of copper; two of these are blue,—the sulphate and nitrate, and one green, the chloride. The salt should be dissolved in water, diluted, and the following TESTS may be then applied. The solutions of the cupreous salts generally have an acid reaction. 1. Solution of ammonia: this gives, in a solution of copper, a bluish white precipitate, which is soluble in an excess of the test, forming a deep violet-blue solution. 2. Ferrocyanate of potash, a rich claret-red precipitate;—if the quantity of copper be small, the liquid acquires merely a light red-brown colour. 3. Sulphuretted hydrogen gas, or hydrosulphuret of ammonia, gives a deep chocolate-brown precipitate, or merely a brown colour if the copper be in small proportion. 4. A slip of polished iron (a common needle) suspended by a thread in the liquid, is speedily coated with a layer of copper, even where the salt is in very small proportion. When much diluted, a drop of dilute sulphuric acid may be added. If the needle be left for some days in the liquid, the iron will be slowly removed, and a hollow cylinder of metallic copper will remain. This may be dissolved in diluted nitric acid, and tested with the foregoing tests. Half a grain of sulphate of copper dissolved in sixteen ounces of water, may be thus easily detected. Among these tests the ferrocyanate of potash and sulphuretted hydrogen gas will produce a marked action on a quantity of the cupreous salt, in which polished iron has no effect. Ammonia fails to indicate with any certainty less than the 100th part of a grain of sulphate in one fluid drachm of water; but the ferrocyanate of potash and hydrosulphuret of ammonia produce an evident effect on a solution containing only the 250th part of a grain of sulphate in half a drachm of water. The iron test failed to detect the 150th part of a grain in a fluid-drachm of water. It is, however, sufficiently delicate for most practical purposes. 5. If a few drops of the copper solution be placed on platina foil,—slightly acidulated with a diluted acid, and the platina be then touched through the solution with a thin slip of zinc, metallic copper of its well-known red colour, is immediately deposited on the platina. When the quantity of copper is small, there is merely a brown stain. This test is not so delicate as the iron test.

Objections to the tests.—Ammonia produces in a salt of nickel, a colour somewhat similar to that produced in a salt of copper; but if caustic potash be added to the ammoniated nickel solution, greenish white oxide of nickel is thrown down:—in the ammoniated solution of copper, potash produces no change if there be sufficient ammonia present. Ferrocyanate of potash precipitates a salt of nickel of a pea-green colour, a reaction very different to that produced on a salt of copper. There are no objections to the use of the ferrocyanate of potash as a test for copper. In an organic liquid containing no copper, I have, however, seen a pink-red colour produced by this salt, but the liquid tests here described should not be applied to solutions of the salts of copper in organic liquids. To the action of the third test, when taken by itself, there are many objections; but these are entirely removed by the application of the other tests. The action of iron and of zinc and platina is peculiar: it is true that there is one other metal of a red colour like copper, namely, titanium; but this is not precipitated by iron or zinc and platina in its metallic state. We may now briefly advert to the specific characters of the different salts.

SULPHATE OF COPPER. (BLUE VITRIOL. ROMAN VITRIOL. BLUE STONE.)—This salt is met with in rhombic masses, transparent, and of a rich blue colour. When reduced to powder it is nearly white, but becomes again blue on melting or dissolving it. It is soluble in four parts of cold and two of boiling water, and is easily obtained in well-defined rhombic crystals by evaporating a small quantity of the solution on a slip of glass. The powder undergoes no change on adding sulphuric acid. Nitrate of barytes added to the solution, indicates the presence of sulphuric acid.

Ammonio-sulphate.—This forms a rich violet blue solution, and is known from the sulphate by producing a green precipitate with a solution of arsenious acid. The sulphate is unaffected by a solution of arsenious acid.

Nitrate.—It is crystallized in prisms of a deep blue colour and very deliquescent,—extremely soluble in water, and the solution is not precipitated by nitrate of barytes or nitrate of silver. When the powdered crystals are mixed with tin filings and moistened with water, nitrous acid fumes are evolved. By adding carbonate of potash to the solution, and filtering, nitrate of potash is obtained in the filtered liquid, and the acid may be thereby identified.

Chloride.—This is seen in deliquescent crystals of an emerald green colour.—It is very soluble in water, forming a deep green solution, if concentrated; but becoming blue when diluted. This diluted solution has the remarkable property of becoming green when heated to 212°, and again blue on cooling. It yields an abundant white precipitate with nitrate of silver insoluble in nitric acid, by which it is easily known.

The insoluble salts of copper, which may give rise to questions of poisoning, are the subacetate, subchloride, carbonate and arsenite. They possess these common characters,—that when rubbed on a steel spatula with a few drops of diluted sulphuric acid, metallic copper is abundantly precipitated on the iron:—and when dropped into a strong solution of ammonia, they acquire a rich violet blue colour.

Subacetate. (Artificial Verdigris.)—There are several varieties of this salt, some of which are blue, and others green. Verdigris is partially soluble in water; but if this be acidulated with acetic or muriatic acid, a solution is immediately obtained, to which the tests for copper may be readily applied. If a portion of the powder be heated in a reduction tube, a film of metallic copper is produced,—and acetic acid vapour escapes. Acetic acid is, however, readily discovered by boiling the powder in dilute sulphuric acid. Sulphate of copper is at the same time produced, which admits of a ready analysis.

Subchloride. (Oxychloride. Baunswick green.)—This is a rich green compound, which is formed where common salt has been used in a copper vessel, and has thus given rise to accidental poisoning. It is insoluble in water; but is easily dissolved by nitric or muriatic acid, and the acid solution will give all the reactions for copper. The simplest way of analysing this compound, is to boil it in caustic potash:—when black oxide of copper is separated. This may be washed, dissolved in an acid and tested while the chlorine may be detected in the filtered alkaline liquid on acidulating with nitric acid and adding nitrate of silver. This test will also detect the chlorine in the nitric acid solution of the subchloride.

Carbonate.—This is a bluish green compound, which is produced in firm crusts, when copper, brass, or bronze is exposed at the same time to the action of water and air. It is often called verdigris to distinguish it from the subacetate or artificial verdigris. When heated on platina foil, carbonic acid is evolved, and black oxide of copper is left. It is insoluble in water; but is dissolved by acids with effervescence, a character which distinguishes it from the other insoluble salts. The acid solution gives the usual reactions with the tests for copper.

A case of poisoning by this substance has been lately reported by M. Degrange of Bordeaux. A man died in about six hours from the effects of an unknown quantity of this poison which he had taken. When first seen he was comatose, and there was great coldness of the extremities. There was neither vomiting, purging nor pain in the abdomen on pressure. On in spection, the œsophagus and stomach were covered with a green coloured substance. The larger extremity of the stomach was vascular; and the mucous membrane corroded in patches. The mucous membrane of the intestines, as well as the liquid contained in them, was green. Carbonate of copper was found in the stomach, and traces of that metal existed in the urine—none was found in the blood. (Med. Gaz. xxxi. 495.) It is remarkable that in this case, there should have been neither vomiting nor diarrhea. The poison seems to have acted more like a narcotic than an irritant.

Verditer is said to be a mixture of carbonate and hydrated oxide of copper:—it is, however, more commonly hydrated oxide mixed with lime, potash and alumina. It is of a rich blue colour, which it owes to the presence of a small quantity of muriate of ammonia. The oxide of copper may be dissolved by dilute acids. This colour is largely employed in paper-staining; but we do not hear of accidents from its use.

Arsenite of copper. (Scheele's green.) This is a powerful poison of a green colour, the depth of which is greater in proportion to the quantity of oxide of copper present. Its poisonous properties are chiefly due to the arsenic contained in it. It is insoluble in water, but soluble in ammonia and the acids. When very gently heated in a reduction tube, arsenious acid is sublimed in minute octohedral crystals. These may be dissolved in water and tested in the usual way—the residuary oxide of copper may be dissolved in nitric acid and tested. With charcoal powder, the arsenite gives, although with some difficulty, a ring of metallic arsenic; but its nature is easily determined by boiling it with diluted muriatic acid and a slip of bright copper. Metallic arsenic is immediately deposited on the copper. This compound is extensively used as a pigment in the arts:—it is also improperly employed to give a green colour to wafers and to articles of confectionary. Dr. Geoghegan informs me that an accident occurred in Dublin, in 1842, by which fourteen children suffered from symptoms of poisoning in consequence of their having eaten some confectionary ornaments coloured with Scheele's green. In two or three of these cases jaundice followed.

There is another kind of green pigment much used, called **Schweinfurth green.**—This is a mixture of arsenite and acetate of copper. The presence of arsenic in this compound is easily detected by muriatic acid and copper. The arsenite of copper has been placed among cupreous poisons; because it so closely resembles them in physical and chemical properties;—and the existence of arsenic in it might be easily overlooked. On the whole, these salts of copper are seldom used as poisons; although so easy of access, that they are to be purchased without difficulty in any colour shop. During the years 1837-8, there was not a single fatal case recorded of poisoning by copper throughout England and Wales.

Copper in organic mixtures.—The oxide of copper is liable to be precipitated by certain organic principles, as albumen, fibrin and mucous membrane: but some of these organic compounds are easily dissolved by acids or even an excess of the cupreous salt. A portion at least of the salt of copper is, therefore, commonly held dissolved. In such cases, there is one peculiar feature possessed by these liquids, i. e. they have a decidedly green colour, when the copper salt is in a far less than poisonous proportion. We first filter the liquid, and save the insoluble portions for a separate operation. We may use as a trial test, a needle—zinc and platina, or add to a portion, oxalic acid; the last gives a bluish white precipitate only when the copper is in moderately large quantity. If the needle be not coated with copper in the course of a few hours, it is certain that there is no detectable quantity of the poison present in the liquid. The needle experiment answers in spite of the presence of a large quantity of organic matter; and a very small quantity of a salt of copper may be thus easily discovered in tea, coffee, porter or gruel, provided we take care to acidulate the liquid slightly with diluted sulphuric acid, before introducing the needle. The following is the result of an actual experiment: One-third of a grain of sulphate of copper was dissolved in water, and mixed with four ounces of thick gruel. Ammonia produced no effect on this liquid; and ferrocyanate of potash gave only a faint reddish brown discolouration. Two drops of diluted sulphuric acid were added to it, and a bright needle suspended in it by a thread. In twenty-four hours, the needle was covered with a distinct film of metallic copper. The quantity of copper-salt here present, was less than the 6000th part of the solution. If the needle be rusty, this experiment will fail. The smaller the quantity of copper, the longer the time required for the result to follow.

If the copper salt be present in largo quantity, the trial tests will indicate it immediately. We now destroy the viscidity of the liquid by diluting it if necessary; and pass into it a current of sulphuretted hydrogen gas in order to precipitate all the copper in the state of sulphuret. The black sulphuret may be collected, washed, dried and then boiled in equal parts of nitric acid and water for a quarter of an hour. Nitrate and sulphate of copper are produced and dissolved, a fact indicated by the liquid acquiring a rich blue colour, and some sulphur is at the same time separated. This liquid, when filtered, will give the usual reactions with the tests for copper.

I have also found the following a very expeditious and simple method of obtaining copper from organic liquids. Having filtered the liquid, let a portion of it be placed in a clean platina capsule or crucible. A few drops of diluted sulphuric acid may be added, and a slip of zinc foil introduced. Wherever the platina is touched by the zinc, metallic copper is deposited; and after having in this way coated the platina capsule, the surplus liquid may be poured off and the capsule well washed out. A few drops of nitric acid with a small quantity of water may be used to dissolve out the metallic copper. In this way, a pure solution of nitrate of copper is obtained,—giving the usual reactions with ammonia, and, when the surplus acid is neutralized,—with ferrocyanate of potash and polished iron. In this way copper, if in moderate quantity, may be separated from milk, gruel, porter, or the most complex organic liquids.

It may happen, however, that there is no poisonous salt of copper held dissolved in the liquid subjected to analysis,—a fact indicated by the entire want of action on polished iron. The oxide of copper may be intimately combined with some organic principles, or even with the mucous membrane of the stomach itself, and exist only in a soluble form. It will then be necessary to cut up those substances, which commonly have a green or blue colour, and boil them for an hour in water containing one sixth part of strong nitric acid. The acid liquid should be filtered, and evaporated to dryness; and if much organic matter be present, this should be destroyed by redigesting it in strong nitric acid, and again evaporating it to dryness. Water will now dissolve out any copper as nitrate, which may have been taken up by nitric acid.

If even this process should yield no copper, the organic matter, thoroughly dried, may be incinerated with two parts of black flux in a crucible. By pulverizing this residue, then carefully rubbing it in a mortar with water, and decanting the liquid, granules of metallic copper may be obtained, which should be dissolved in diluted nitric acid, and tested in the usual way.

It has been objected to this last-mentioned process of calcination, that copper is contained as a natural constituent in most of the organs of the body, and the term normal copper has been applied to it. According to Sarzeau, this metal is also present in the incinerated residue of sugar, coffee, madder, wheat-flour, and likewise in cheese. Blood, milk and other liquids of the body, in cases where no poisonous salt of copper had been taken, are said to have also yielded it. One chemist made a mixture of eggs, somo strong coffee and bread and butter; he dried and incinerated the mass, and detected copper in the residue. The metal is said to have been found in bread, beef, and mustard. Thus then, according to this view, copper exists naturally, not only in the organs of tho human body, but likewise in somo of the most common articles of food. It is, however, by no means improbablo that copper may, in these cases, have been introduced accidentally during the analysis, and thus have led to an erroneous inference, especially as it was only found in infinitesimal traces. Dr. Christison could not detect any portion of the metal in the animal fluids; and in some experiments on large quantities of oatmeal and bread, I did not detect the smallest portion of copper, although the tests perfectly answered when a cupreous salt was purposely added in minute proportion.

In a practical view an objection of this kind amounts to nothing; 1. Because in poisoning by copper, there would be very few cases in which all the chemical evidence rested on an incineration of the viscera:—such a case is very unlikely to occur; for chemical evidence is in general abundantly afforded by an analysis of a portion of the poisoned substance swallowed or of the contents of the stomach. 2. If the only chemical evidence were that derived from incineration, then this could afford no proof of poisoning, unless that fact were already sufficiently made out by symptoms, post-mortem appearances, and moral circumstances, in which case such infinitesimal proof might be very easily dispensed with. In a case of falsely imputed poisoning, it might be said that the detection of copper in a particular article of food, such as bread, would lead the medical jurist into error, since the discovery of the metal in the bread might bear out the imputation and inculpate an innocent person. This hypothesis does not appear probable;—the normal copper, said to exist in food, has not been found to form more than the 100,000th part of the food examined:—if the imputation of poisoning were well founded, and copper were discovered at all, the metal would be in infinitely larger proportion, so as to leave no doubt of its actual admixture.

M. Boutigny has pointed out that in the process of incineration, the copper may be concealed and withdrawn from the action of the tests, by the presence of iron in the acid liquid. He has therefore advised that this should be first got rid of by the addition of ammonia.

If we except the recent case of M. Dégrange, copper has not been discovered in the blood, organs or secretions of the human subject, where its salts have been taken as poisons. This may arise more from the rarity of this form of poisoning, than from any chemical difficulty in the detection of the metal. Orfila has found the metal in the lungs, heart, liver, spleen, and kidneys, of animals poisoned by it; but he could discover no traces of it in the blood or urine. Wibmer, according to Sobernheim, detected copper in the liver of a dog to which he had for several weeks given small doses of the sulphate. M. M. Danger and Flandin have recently stated, that copper in these cases, is to be detected more readily in the serous exhalation of the chest, than in the urine.

Quantitative analysis.—This is best determined by converting the salt of copper to the state of black oxide, every 100 parts of which, are equal to 312 of crystallized sulphate, and 392 of crystallized nitrate. If the cupreous salt be precipitated as sulphuret, this may be transformed to black oxide by digestion in nitric acid, and subsequent precipitation by potash.

The medico-legal history of poisoning by copper would be incomplete without some remarks on the action of certain articles of food on this metal when used for culinary purposes. This is a not unfrequent form of accidental poisoning, but we seldom hear of its terminating fatally. It results from the experiments of Falconer and others, that metallic copper undergoes no change by contact with water, unless air be present; when a hydrated carbonate will be formed mixed with peroxide. If the water contain any acid, such as vinegar, or common salt,—or there be oily or fatty matter in contact with the metal, then the copper is more rapidly oxidized, and the liquid or fat acquires a green colour. If the copper vessel be kept perfectly clean, and the food prepared in it, be allowed to cool in other vessels, there is not much risk of its acquiring a poisonous impregnation:—nevertheless no acid, saline, or oily liquid should be prepared as an article of food in a copper vessel. The preparation of fruits as preserves in copper vessels, is necessarily attended with some risk; for on cooling, a green crust is apt to form on the copper, just above the surface where the air and acid liquid meet. Some substances appear to be but little liable to this impregnation:—thus, coffee, beer, milk, or tea has been boiled for two hours together, in a clean copper vessel, without any portion of the metal being taken up by those liquids. See Falconer on the Poison of Copper, 65. London, 1774.

Accidents of this kind are usually prevented by lining the copper vessel with tin; but in very large boilers this plan is not always adopted—cleanliness alone is trusted to; and the following case will show that too much confidence may be sometimes put in this process of tinning. It is related by Professor Barzellotti, and he himself narrowly escaped partaking of the poisonous food.

At a monastery near Sienna, the monks were one day, soon after dinner, seized with violent symptoms of irritant poisoning. They suffered chiefly from severe pain in the abdomen, nausea, difficulty of passing urine, spasms of the muscles and trembling of the limbs. Those who were affected with vomiting and purging, were speedily relieved; but others, who had no evacuations, suffered from vertigo, cephalalgia, intense thirst, and an unpleasant taste in the mouth. Remedies were applied, and they all eventually recovered. It appeared, on inquiry, that the monks were in the habit of keeping their salt-fish in the copper vessel, in which it was dressed for a second day's meal. This vessel was badly tinned; and when the fish was examined, it was found covered with a green jelly, and the sides of the vessel with which the fish was in contact, had a green colour. The cause of the symptoms was no longer doubtful:—subchloride of copper had here been formed by the action of the salt on the metal. (Quest. di Med. Leg. ii. 185.)

In April, 1838, I was required to examine the following case. In an extensive poor-law union, a number of the paupers had been seized with diarrhea and dysentery, and several of them died. There was no apparent cause for this sickness and mortality; and it was suspected, that the soup which was daily prepared in large copper boilers, might have become impregnated with that metal, and have given rise to the symptoms, although these were scarcely indicative of irritant poisoning.

I ascertained that the copper vessels were cleaned out daily, that the soup was made with salt and vegetables, but was poured into other vessels to become cool. The soup was given only once a week; but the gruel which was also suspected, was given daily to the paupers. Four ounces of the soup clarified by standing, gave no trace of copper by the iron test: and the liquid was wholly unaffected by a current of sulphuretted hydrogen gas. Eight ounces were evaporated to dryness, and calcined with flux;—an abundant ash resulted, presenting iridescent colours, many portions having a bright *coppery* lustre. The ash was treated with water, and the heavy residue digested with diluted nitric acid. The filtered liquid, when neutralized, gave no sign of the existence of copper with any of the tests:—iron was present, as it is in the incinerated residue of most vegetables. This experiment, while it showed the absence of copper as a poison, also appears to prove that articles of food do not always contain it as a natural constituent. The analysis of the gruel was equally negative. The bread was also examined without any noxious irritant substance being discovered in it. It was therefore evident that the symptoms could not have been due to irritant poison.

The fatal effects resulting from the impregnation of acid liquids with copper, are established by the following accident, which occurred a few years since.

A servant girl at a farmhouse put a copper vessel into a tub, containing the wash with which the pigs were fed. This is said to be a common practice in many parts of the country, as the acidity of the liquid serves to cleanse the copper vessel. A number of pigs were fed with this wash, and six of them died;—their bodies were examined, and the stomachs were found inflamed. Owing to the ignorance which prevails on these matters, soup and other articles of food are often improperly kept in copper vessels.

In the making of preserved fruits and vegetable pickles, the salts of copper (blue vitriol) are sometimes used for the purpose of giving a rich green colour. Many of the green pickles, sold in shops, are thus impregnated with the vegetable salts of this metal, to which they owe their grass green colour. If the fruit or pickle be placed in solution of ammonia, and copper be present, it is immediately turned blue. The iron test is, however, more delicate. The quantity of copper contained in such articles, may not be sufficient to produce fatal effects; but serious symptoms of gastric irritation may be produced, and in very young subjects, these may assume an alarming character. (See Falconer, 87.)

A short time since some preserved gooseberries were sent to me for examination, as it was suspected from circumstances that they were contaminated with copper. The liquid in which they were preserved was of a pale yellow colour, and had an acid reaction. Ammonia gave with it a dark greenish tinge; ferrocyanate of potash a rich claret-red precipitate; and hydrosulphuret of ammonia a deep brown. A needle plunged into it was coated with copper in about five or six minutes. The galvanic test applied in the usual way failed to indicate the presence of the metal. I therefore modified it by plunging into the liquid a slip of platina, having a coil of zinc twisted round it:—copper was then deposited on the platina in the course of a short time. The liquid gave a precipitate with nitrate of barytes, insoluble in nitric acid. These facts proved that the liquid was pretty strongly impregnated with sulphate of copper:—and the analysis shows that ammonia is decidedly inferior to the other tests, the blue colour having been concealed and changed to green by the yellow colour of the liquid. The test upon which reliance may always be placed, is that with iron; and this, while it is the least open to objection, happens at the same time to be very delicate in its reaction, and less affected than the others by the presence of organic matter.

A few years since, a fraudulent practice existed on the continent, of mixing sulphate of copper with the dough of bread, in order, as it was said, to accelerate the panary fermentation. The quantity of cupreous salt used was small, but still it was a noxious adulteration. I am not aware that this practice has extended to England.

Accidental poisoning by copper has occurred from the use of what is called German silver, but which should rather be called white brass, as it is an alloy of copper and zinc with nickel. Some specimens of this alloy contain fifty per cent. by weight of copper. The following case of poisoning occurred in Paris in 1838. A lady, after having had eels for dinner, was awakened in the night by intense headache, followed by nausea, vomiting, and colic. These symptoms were removed under proper treatment. Her physician ascertained that the eels had been cooked with butter and vinegar in an earthenware vessel, and he found the metal spoon, which was of German silver, presented on different parts greenish spots. Chemical analysis showed that a poisonous salt of copper had been thus accidentally produced:—a fact proved by polishing the spoon, and then placing it in a hot mixture of bread, butter and vinegar. Half an hour after the mixture had cooled, green spots were perceived on it; and in twelve hours the spoon was quite green, as well as the butter in contact with it.

CHAPTER XXI.

ON POISONING BY ANTIMONY, TIN, ZINC, SILVER, AND IRON.

THERE are several preparations of these metals which require to be noticed as poisons, although it is extremely rare to hear of death being produced by any of them. Among the antimonial compounds, there are two which may be specially considered; namely, tartar emetic, and butter of antimony.

TARTARIZED ANTIMONY. (TARTAR EMETIC. STIBIATED TARTAR.)—This substance, which is seen in the form of white powder or in crystals, is by no means so poisonous as it is often described to be. Forty grains have been given to an adult in twenty-four hours without causing serious mischief. Professor Forget of Strasburg has related the case of a robust man, aged forty, who, while labouring under acute rheumatism, took tartar emetic, first in the dose of eight grains, increasing it gradually to sixty, and then to seventy-two grains. He took this quantity without any disorder of the intestinal canal, or any other bad symptom. In the space of ten days, the man took without inconvenience three drachms of tartar emetic. (Med. Gaz. xxiv. 126.) Nevertheless other facts show, that this substance in doses of from half an ounce to one ounce, or even less, must be regarded as an irritant poison; and one reason why the symptoms are often so slight from comparatively large doses, is owing to its possessing such violent emetic properties. This leads to the expulsion of the greater part of the poison from the stomach. A case is related by Dr. Lambert, where only four grains of this substance gave rise to violent pain in the abdomen, vomiting and purging. The individual then fell into strong convulsions, which lasted half an hour. He became speechless, no pulse could be perceived, and the skin was quite cold;—in short, it was supposed he was dead. Stimulating frictions and cataplasms were employed, and he slowly recovered in about fourteen days. (Casper's Wochenschrift, xiii. 1241.)

Tartar emetic appears to act more as an irritant than as a corrosive; but the symptoms which it produces, like those of all corrosive poisons, are generally immediate. Two deaths have recently been caused by this substance in England, and one or two fatal instances are reported by Orfila to have occurred in France. Our knowledge of its effects as a poison on man, are derived from the cases related by Orfila. In 1837, a trial took place on the Norfolk circuit for the administration of this substance with intent to murder; but there was a total want of proof: the tartar emetic was given to a child medicinally by the prisoner, an ignorant woman, without there being apparently any intention on her part to destroy life.

Symptoms.—A strong metallic taste is perceived in the mouth during the act of swallowing. There is violent burning pain in the epigastric region, followed by nausea, vomiting, profuse diarrhea and syncope. The pulse is small and rapid: the skin cold or hot, and the respiration painful. Death is preceded by vertigo, insensibility, great prostration of strength, and spasms of the extremities. Among the symptoms there has been great constriction in the throat, with difficulty of swallowing. The quantity actually required to destroy life is unknown. It will probably depend much on whether active vomiting and purging have been excited or not; for these symptoms have not been present in all cases. Doses of twenty, twenty-seven, and even sixty grains have been taken without destroying life; although alarming symptoms of irritation followed. In one case related by Orfila, a man aged 50, took forty grains of tartar emetic and died in about four days. This was the only one out of five cases of poisoning by this substance which proved fatal. (Orfila, i. 477.) Dr. Beck mentions a case in which fifteen grains of tartar emetic, in solution, killed a child in a few weeks: vomiting and purging ensued, followed by convulsions and death. This, I believe, is the smallest fatal dose on record. Tartar emetic is said to have produced symptoms of irritant poisoning when applied externally to the skin, in the form of ointment as a counter-irritant. In a case where the skin was but little affected by the use of this ointment, nausea and sickness were produced, which disappeared when the use of the ointment was discontinued. Although it is very extensively used by medical practitioners, we never hear of cases of poisoning by it under these circumstances.

Post-mortem appearances.—In Orfila's case above-mentioned, the mucous membrane of the stomach and duodenum was reddened and covered with a slightly adhering layer of mucus. In a man who had taken forty grains of tartar emetic in a period of five days, and who then died from an attack of apoplexy,—the stomach was found much reddened and inflamed in irregular patches, the redness passing into a violet tint; but there was no ulceration of the mucous membrane,—the duodenum was in a somewhat similar state, and the small intestines but slightly inflamed. In animals poisoned by this substance, it is common to find general inflammation of the alimentary canal.

Treatment.—This consists in promoting vomiting by the free administration of warm water, milk, or other diluents. The stomach-pump may also be used. Any vegetable infusion containing tannin, such as tea, decoction of oak-bark, or Peruvian bark, may be given. This principle combines with oxide of antimony, to form a compound insoluble in water; and if attended with no other benefit, it at least suspends the operation of the poison. This tannate of antimony is said to be inert: it is easily taken up by some vegetable acids. Should the decoction not be at hand, bark may be given either in the form of tincture or powder. Some cases are reported, in which this treatment appears to have been attended with the most decided benefit.

CHEMICAL ANALYSIS.—As a *solid.* In the state of powder,—1. Tartar emetic is easily dissolved by water,—it is taken up by fourteen parts of cold, and two of boiling water;—the solution has a faint acid reaction, and an acrid caustic taste,—it becomes decomposed by long keeping. It is insoluble in alcohol. 2. The powder dropped into hydrosulphuret of ammonia is turned of a deep reddish-brown colour, and is thereby known from other poisonous metallic salts. 3. When heated in a reduction tube, it becomes charred, but does not melt before charring, like the acetate of lead. The metal is partially reduced by the carbon of the vegetable acid, and the decomposed mass has a greyish-blue lustre. No metallic sublimate is produced in this experiment, under any circumstances. 4. When boiled with muriatic acid and metallic copper, a grey deposit of antimony takes place on that metal. The colour is violet if the quantity be small. In *solution.* 1. On slowly evaporating a small quantity on a slip of glass, it will crystallize in tetrahedra. 2. Dilute nitric acid added to the solution, throws down a white precipitate, (subnitrate of antimony,) the other two mineral acids act in the same way; but as they precipitate numerous other metallic solutions, there are objections to them which do not hold with respect to nitric acid. The white precipitate thus formed, possesses the remarkable property of being entirely redissolved by a solution of tartaric acid:—it is also soluble in a large excess of nitric acid, so that if much of the test be added at once, no precipitate is formed. 3. Ferrocyanate of potash does not precipitate the solution, whereby tartar emetic is known from other metallic poisons. 4. Hydrosulphuret of ammonia or sulphuretted hydrogen gas, produces in the solution, a reddish-orange coloured precipitate,—differing in colour from every other metallic sulphuret. If the solution be very much diluted, the colour may somewhat resemble that produced in a solution of arsenic; but as the precipitate is produced in the antimonial solution by hydrosulphuret of ammonia, and this test does not affect a solution of arsenic, the difficulty, if any exist, is at once removed. The precipitated sulphuret of antimony produced by sulphuretted hydrogen possesses the following properties; *a*, it is soluble in potash, and also partially in a large excess of ammonia, thus differing from the sulphuret of cadmium; *b*, it is soluble in strong muriatic acid, thus differing from the sesquisulphuret of arsenic; *c*, when collected and dried it is decomposed by boiling muriatic acid, sulphuretted hydrogen is evolved, and a solution of chloride of antimony is thus formed. In this way we may separate the sulphuret of antimony from that of arsenic, but muriatic acid added to a mixed liquid will not prevent the precipitation of antimony with arsenic. 5. A small quantity of the solution of tartar emetic may be introduced into Marsh's apparatus:—on igniting the hydrogen gas, if antimony be present it will burn with a yellowish-white flame evolving a white smoke. A black smoky sublimate is obtained on glass and copper—having rings of white or grey oxide of antimony; but without any decided metallic lustre, unless examined through the reverse side of the glass. This deposit should be digested in nitro-muriatic acid; on evaporating to dryness white oxide of antimony remains, which is turned of a red-brown colour when moistened with hydrosulphuret of ammonia. In this way, the smallest traces of the poison may be detected. Marsh's test serves to distinguish antimony from every other metallic poison except arsenic; and the differences between these two metals have been already fully described. The production of an iron-grey deposit on metallic copper by boiling the solution of tartar emetic with muriatic acid, distinguishes antimony from all other metals except arsenic and bismuth.

Numerous other tests might be mentioned; but I have here selected those which will convey absolute certainty of the nature of the poison. The galvanic test does not succeed so well with this as with the other poisonous metallic salts. On placing the solution in a platina capsule,—acidulating with muriatic acid and touching the platina through the solution with a slip of zinc, antimony is deposited in the form of a black powder; but the nature of this cannot be easily identified.

The foregoing tests, it will be observed, merely indicate the presence of oxide of antimony,—but this is in reality the poison which we have to seek,—the cream of tartar with which it is combined, being merely the vehicle, and in a case of poisoning this is no more the object of medico-legal research, than if it were the vehicle for the administration of arsenic or corrosive sublimate. It is besides well-known, that tartar emetic is the only salt of the oxide of antimony in a soluble form, which is likely to be met with in medicine or chemistry. Should it be required to prove the presence of cream of tartar, this may be done by filtering a solution from which the oxide of antimony has been entirely precipitated by sulphuretted hydrogen gas. On evaporating this solution the cream of tartar may be obtained.

Objections.—I know of no objections to the various tests recommended, when taken together. The action of sulphuretted hydrogen is peculiar. Marsh's test may be dispensed with, when the others answer; since this last is rather for the purpose of detecting small quantities of the poison, than for determining its real nature.

In Organic liquids.—Tartar emetic is precipitated by tannin in all its forms; but not readily by albumen or mucous membrane, therefore it may be found partly dissolved in the liquids of the stomach, provided no antidote have been administered. The liquids must be filtered; and as a trial test, a slip of paper may be dipped into it and then exposed to a current of sulphuretted hydrogen gas, or immersed in hydrosulphuret of ammonia. If the poison be in a soluble form, there will be an orange-red stain produced on the wetted portion of paper; this stain being immediately dissolved by caustic potash, but not readily by ammonia. Muriatic acid and copper will also serve as a useful trial test. If the tartar emetic be mixed with albumen, or the paper be allowed to become dry, before it is exposed to sulphuretted hydrogen, the stain is yellow, thus resembling that of arsenic. Sobernheim has observed a similar difference when tartar emetic is mixed with solution of gum. In analyzing the contents of a stomach, we might therefore be erroneously led to suspect the presence of arsenic, since tartar emetic is frequently given as a medicine.

Having ascertained that antimony is present, sulphuretted hydrogen gas is passed into the liquid previously acidulated with tartaric acid, until there is no further effect. The sulphuret is collected, washed, and dried. If it be the sulphuret of antimony, it will have an orange-red or brown colour; and will, when dried, be dissolved by a small quantity of boiling muriatic acid with evolution of sulphuretted hydrogen. The boiling should be continued for several minutes. On adding this solution to a large quantity of water, a dense white precipitate of oxychloride of antimony will fall down. This is characteristic of antimony; if it be objected that nitrate of bismuth undergoes a similar change when dropped into water, hydrosulphuret of ammonia will easily enable us to distinguish the two metals; the antimonial precipitate is turned of an orange-red by that solution, while the bismuthic precipitate is turned of a deep black. Besides the white precipitate from antimony is known from that of bismuth by its ready solubility in tartaric acid.

Dr. Turner recommended that the precipitated sulphuret of antimony should be reduced by heating it in a current of hydrogen; but there are some objections to this. Dr. Turner himself found that organic matter became precipitated with the sulphuret, and interfered with the metallic appearance after its reduction; and even supposing the metal to be obtained, it will require to be identified by certain chemical processes. The production of the chloride from the sulphuret, with its peculiar properties, is more expeditious and quite satisfactory. Antimonial wine may be thus readily analyzed.

Supposing that there is no antimony in solution, we take the solid substance left on the filter,—the mucus of the stomach or other matters, and boil them in water strongly acidulated with tartaric acid. The insoluble compounds of oxide of antimony are immediately dissolved by this acid. We now filter and pass into the liquid sulphuretted hydrogen gas; sulphuret of antimony is precipitated if any of the poison be present, the vegetable acid not interfering with the action of the gas.

If these processes fail, antimony may still be discovered in the solid tissues of the body. For this purpose, Orfila recommends, that the viscera should be thoroughly dried and added gradually to boiling nitric acid, until dissolved. Evaporate to dryness and carbonize. Boil the carbonaceous residue in muriatic acid with a little nitric acid. This converts the antimony to chloride,—a portion of which may be introduced into Marsh's apparatus, and tried for antimonial sublimates. If these be obtained, they may be tested in the way described. Another portion of the liquid may be evaporated on a slip of glass, and the white residue, if any, treated with sulphuretted hydrogen or hydrosulphuret of ammonia. Should antimony be present, it will be indicated by the formation of an orange-red sulphuret. By this process, Orfila has succeeded in detecting antimony in the urine, liver and other viscera, a clear proof that it is absorbed. He failed to discover it in the blood, or in any animal fluid except the urine.

A medical jurist must remember that the discovery of tartar emetic in the contents of a stomach, is by no means a proof of its having been taken or administered as a poison; since it is frequently prescribed as a medicine, and often taken as such by persons of their own accord. We could only infer that it existed as a poison, or had caused death, when the quantity present was very large, and there were corresponding appearances of irritation in the alimentary canal. Any sulphuret of antimony may be separated from that of arsenic, by digesting the dried precipitate in muriatic acid; chloride of antimony is formed.

Quantitative analysis.—The quantity of tartar emetic present in a liquid, may be determined by the weight of the washed and dried sulphuret of antimony: one hundred parts of the dried sulphuret (sesquisulphuret) by weight, are equal to 202·78 parts of crystallized tartarized antimony.

It is important, perhaps, in a medico-legal view to state, that arsenic has been discovered by Serullas, to exist in the common sulphuret of antimony, in the metal, and in the preparation called kermes. In the common sulphuret, it has been found in the proportion of from two to five per cent. It has been supposed that pharmaceutical preparations of antimony may be thus contaminated with arsenic; but it does not appear that tartar emetic, when well crystallized, contains any traces of that poison;—the mother liquor contains it, and sometimes the last crops of crystals which are obtained from the solution may hold a portion of arsenic.

Chloride of antimony. (Butter of antimony.) This is a highly corrosive liquid, varying from a light yellow to a dark red colour:—in the latter state containing generally a large quantity of iron. It is a powerful poison, but it is not often taken as such. Orfila mentions only one, and that a doubtful instance, which occurred nearly two hundred years ago. I have the accounts of three cases of recent occurrence, in two of which recovery took place, while the other was fatal. One of my pupils, Mr. Henry Pearson, communicated to me the following case: In 1836, a boy, aged 12, swallowed by mistake for ginger beer four or five drachms of a solution of butter of antimony. In half an hour he was seized with vomiting, which continued at intervals for two hours. There was faintness with general weakness, and great prostration of strength. Remedial means were adopted, and the next day the chief symptoms were heat and uneasiness in the mouth and throat, with pain in swallowing. There were numerous abrasions on the mucous membrane of the mouth and fauces, attended with slight fever, from which he quite recovered in about eight days.

The second case has been lately reported by Mr. Houghton, of Dudley: it occurred in 1841. In this instance, about a table-spoonful of the chloride of antimony was given by mistake for antimonial wine, to a boy aged 10. Immediately on drinking it, the boy seemed choked:—his features were set, and he was unable to speak for some minutes. He vomited freely,—gruel was given to him, which was rejected: he complained of great pain in his throat. Medical assistance was sent for, and about two hours after swallowing the poison, the child laboured under the following symptoms. The features were pale and collapsed, the eyes sunk,—the pupils dilated and inactive,—the skin cold,—the mouth filled with a thick tenacious transparent mucus,—nausea, vomiting,—pulse 80 and small, and breathing heavy. He was in a kind of stupor, from which he could, however, be roused to answer questions rationally. He felt a severe burning pain in the throat, extending to the stomach,—increased by deglutition. Under active medical treatment, these alarming symptoms were removed;—on the following day it was observed, that there were patches of a bright scarlet colour in the throat, with difficulty of swallowing. In the course of a few days the boy recovered.

The only fatal case which I have met with was communicated to me by Mr. Mann of Charterhouse Square. An army surgeon swallowed, for the purpose of suicide, from two to three ounces by measure of chloride of antimony. About an hour afterwards he was seen by Mr. Mann. There was entire prostration of strength, with coldness of skin, and incessant attempts to vomit. The most excruciating griping pains were felt in the abdomen; and there was a frequent desire to evacuate the bowels, but nothing was passed. In the course of a few hours reaction took place, the pain subsided, and the pulse rose to 120. There was now a strong disposition to sleep, so that he appeared as if labouring under the effects of a narcotic poison. In this state he continued until he died,—ten hours and a half after he had swallowed the poison.

On inspection the interior of the alimentary canal, from the mouth downwards to the jejunum, presented a black appearance, as if the parts had been charred. In general, there was no mucous membrane remaining, either on the stomach or elsewhere;—only a flocculent substance, which could be easily scraped off with the back of the scalpel, leaving the submucous tissues and the peritoneal coat. All these parts were so soft that they might be easily torn with the fingers.

Chemical analysis.—If any portion of the chloride be left in the vessel, it may be tested by adding a few drops to a large quantity of water, when the whitish-yellow oxychloride of antimony will be precipitated: the supernatant liquid containing muriatic acid, which may be detected by nitrate of silver. It has been already observed, that the only objection to this mode of testing, is, that the salts of bismuth are also decomposed by water; but the precipitate in this case is insoluble in tartaric acid, and is blackened by hydrosulphuret of ammonia; while in the case of antimony, it is soluble in that acid, and is changed to an orange-red by the hydrosulphuret. If the chloride contain much iron, it will be proper to separate the white precipitate, and wash it thoroughly with water, before adding the hydrosulphuret, or the presence of iron will conceal the orange-red colour. A piece of copper, when heated in a solution of chloride of antimony, is immediately coated with a layer of that metal of a grey colour, like arsenic.

Solutions of tartar emetic and chloride of antimony are very differently affected by tests. Nitric acid precipitates the former, but not the latter. Ferrocyanate of potash has no effect on solution of tartar emetic, but it precipitates the chloride of antimony of a yellow-white; or if much iron be present, Prussian blue is abundantly thrown down.

The chloride, as a corrosive, combines with the animal tissues. It may be separated in such cases by boiling them in muriatic or intromuriatic acid. In this way, the organic matter will be decomposed.

POISONING BY TIN.—The only preparations of this metal, which require to be noticed as poisons, are the *chlorides*, or *muriates*, a mixture of which is extensively used in the arts, under the name of DYER'S SPIRIT. The salts may exist in the form of whitish yellow crystals; but more commonly they are met with in a strongly acid solution in water. They are irritant poisons; but so seldom used as such, that only one death occurred from them in England and Wales during a period of two years. They are decomposed by many organic principles, and milk or albumen should be freely used in treating a case of poisoning by them.

CHEMICAL ANALYSIS. PROTOCHLORIDE.—In the solid state it forms a milky solution with water, which disappears on the addition of muriatic acid. The acid solution in water is characterized by the following properties: 1. Chloride of gold gives a deep purple-brown precipitate, almost black. 2. Bichloride of mercury, in small quantity, gives a white passing to a grey precipitate of metallic mercury. 3. Sulphuretted hydrogen gas or hydrosulphuret of ammonia, gives a deep chocolate-brown precipitate, even in diluted solutions. 4. Nitrate of silver gives a white precipitate insoluble in nitric acid, thus proving the presence of muriatic acid or chlorine. BICHLORIDE OF PERMURIATE. This is a highly acid liquid; it is not precipitated by chloride of gold or bichloride of mercury. It is known from other metallic poisons, except arsenic and cadmium, by giving a yellowish precipitate with sulphuretted hydrogen gas. It is known from an arsenical liquid, among other properties, by this yellow precipitate being insoluble in ammonia, and from cadmium by the yellow sulphuret of tin being insoluble in muriatic acid. When heated with black flux, it yields no metallic sublimate. The solution is also precipitated of a yellow-brown colour, by the hydrosulphuret of ammonia. Nitrate of silver will detect the acid. If we have to search for these poisons in the stomach, the better way will be to boil the solids in strong muriatic acid. This dissolves out in great part the oxide of tin. If this should fail, the viscera may be dried and calcined with three or four parts of black flux, when metallic tin will be obtained in the residue.

POISONING BY ZINC. (SULPHATE OF ZINC. WHITE VITRIOL.) This substance is ranked among irritant poisons, although it is certainly not very active as such. In doses of from a scruple to half a drachm, it is given as an emetic in most cases of poisoning; and as it frequently presents itself in the contents of the stomach in such cases, it is important that the medical jurist should be acquainted with its chemical properties. In order to show the slightly irritant effects of this substance, it may be stated that Dr. Babington of Guy's Hospital gave to a girl aged 17 thirty-six grains three times a-day for several weeks without any sickness or other untoward effect being produced. When the dose was raised to forty-two grains, which the girl continued to take for one week, she lost her appetite and felt much sickness (G. H. Rep. No. 12, p. 17). This must be regarded as a somewhat unusual case. Orfila refers to two instances, wherein sulphate of zinc was taken in a pretty large dose; but both of the patients recovered: in fact, in general, the powerfully emetic properties of this substance, interfere with its action as an irritant; since it is speedily expelled from the stomach by vomiting. Nevertheless, in four or five instances reported by continental writers, this poison has destroyed life, but there is no instance recorded of its having operated fatally in England. It could scarcely be used as a poison by a murderer, since it possesses a strongly metallic taste, which would not be easily concealed by any kind of food. The SYMPTOMS produced by an over-dose are pain in the abdomen and violent vomiting, coming on almost immediately, and diarrhea.

APPEARANCES.—After death, the stomach has been found inflamed. The sulphate appears to act as a pure irritant; it has no corrosive properties.

TREATMENT.—Warm water, with milk, should be freely exhibited: it has been recommended to give albumen as an antidote, but it requires a very large quantity of this substance to precipitate the oxide of zinc. All infusions containing tannin may be usefully exhibited, such as oak bark, or Peruvian bark, or these substances may be given in powder. A strong decoction of tea will equally answer. If the poison should have entered into the intestinal canal, a fact indicated by severe pain in the abdomen, enemata may be administered.

CHEMICAL ANALYSIS.—The pure sulphate is seen in white prismatic crystals, closely resembling in appearance, sulphate of magnesia and oxalic acid; from oxalic acid it is distinguished, by being fixed when heated on platina foil,—from the sulphate of magnesia, by tests applied to its solution. It is readily dissolved by water: this fluid taking up about one third of its weight at common temperatures. Analysis of the *solution.* The solution in water has a slightly acid reaction. The following tests may be used for the detection of oxide of zinc: 1. Ammonia gives a white precipitate soluble in an excess of the alkali. 2. Sesquicarbonate of ammonia, a white precipitate, also soluble in a large excess of the test. 3. Ferrocyanate of potash, a white precipitate. 4. Sulphuretted hydrogen and hydrosulphuret of ammonia, a white milky precipitate, provided the solution be neutral, or nearly so. If the solution be very acid, sulphuretted hydrogen produces no effect whatever. These last-mentioned tests also throw down sulphuret of zinc from the precipitates dissolved by ammonia and its sesquicarbonate. 5. Sulphuric acid in the solution, is detected by the usual test, nitrate of barytes.

Objections.—Ammonia gives a white precipitate with numerous solutions, as with magnesia, the salts of lead, cadmium and the persalts of mercury; but it redissolves only the precipitate from zinc. Sesquicarbonate of ammonia precipitates many salts white; but it is only the precipitate from zinc, which it has the power of redissolving. This test, by giving no precipitate with sulphate of magnesia, clearly distinguishes that salt from sulphate of zinc. Ferrocyanate of potash is a delicate test, since it will show the presence of the sulphate of zinc when forming only the 40,000th part of the solution; but it precipitates numerous other metallic salts white; and is therefore only a corroborative test. The action of sulphuretted hydrogen is perfectly characteristic of zinc; since this is the only metal, the salts of which are thrown down white by it. In order to precipitate it effectually, the oxide of zinc should be precipitated and redissolved by ammonia, and the gas then passed into the alkaline solution.

The common white vitriol of commerce is in rough reddish white irregular semi-crystalline masses. When dissolved in water, the action of the tests is somewhat different, because this substance usually contains iron. Thus, oxide of iron is left on redissolving the precipitate given by ammonia and its sesquicarbonate; the precipitate with ferrocyanate of potash is blue or bluish-white, instead of white; and the sulphuret thrown down by the fourth test, is of a dark brown colour.

Among the common salts which might be mistaken for zinc in solution is alum; for this last is precipitated by all the tests above-mentioned, except sulphuretted hydrogen gas and ferrocyanate of potash. It strongly resembles a metallic solution, in being precipitated by hydrosulphuret of ammonia, owing to the alkali separating alumina; but the non-precipitation by ferrocyanate of potash, and the insolubility of the precipitated alumina in the ammoniacal tests, would easily distinguish a solution of alum.

In organic mixtures.—If the sulphate of zinc be dissolved, we may pass in a current of sulphuretted hydrogen; its presence is immediately indicated by a milky-white froth,—the sulphuret may be collected, and decomposed by boiling it with muriatic acid. The white sulphuret of zinc is apt to conceal faint traces of arsenic, where it has been given as an emetic in cases of arsenical poisoning. Reinsch's test may then be used to detect the presence of that poison; the sulphuret of arsenic is soluble in ammonia, and may thus be separated from that of zinc, but muriatic acid will answer better for this separation; it converts the sulphuret of zinc to a soluble chloride, but does not affect the sulphuret of arsenic. By very strongly acidulating a mixed liquid with muriatic acid before passing into it a current of sulphuretted hydrogen gas, arsenic only is precipitated. The analyst must remember, that zinc sometimes contains traces of cadmium; and this has been known to give rise to a wrong suspicion of the presence of arsenic in zinc and its compounds.

If the salt of zinc be decomposed, and we have to search for it in the mucous membrane of the stomach, this may be cut up and boiled in dilute nitric acid; and if necessary, the nitrate may be neutralized by ammonia, and thrown down as sulphuret by a current of sulphuretted hydrogen gas. The viscera may be also incinerated with flux,[4] and the zinc procured in the metallic state.

QUANTITATIVE ANALYSIS.—The zinc should be converted to oxide, every one hundred parts of which are equal to three hundred and fifty-seven parts of crystallized sulphate.

CARBONATE OF ZINC. (CALAMINE.) This does not appear to have any poisonous action; and it would probably require to be given in large quantity to produce any effect. This is the white substance which is formed on zinc when long exposed to air and moisture. Its effects may become a subject of investigation as a matter of medical police; since zinc is now much used for roofing, as also in the manufacture of water-pipes and cisterns.

CHEMICAL ANALYSIS.—The pure carbonate is a white powder, insoluble in water, although possessing a faint alkaline reaction. It becomes yellow when heated, and undergoes no change in hydrosulphuret of ammonia. It is dissolved with effervescence in dilute sulphuric acid; and in this state, the tests for zinc may be readily applied to the solution. CALAMINE is an impure carbonate destitute of poisonous action. It consists of carbonate of zinc, silicate of zinc, and peroxide of iron, which gives it a red colour. Some specimens are said to contain sulphate of barytes.

CHLORIDE OF ZINC is a very soluble deliquescent salt; the chlorine is detected by nitrate of silver.

ACETATE OF ZINC.—This is a white crystalline salt of zinc, but very little used. It may be mistaken for sulphate of zinc, especially as it often contains some of that salt. It is known by boiling it in diluted sulphuric acid, when the acetic acid is expelled and identified by its odour.

LACTATE OF ZINC.—Zinc has been lately used in making utensils for holding milk during the separation of cream. It is probable that some of this salt is here formed, as well as a combination of oxide of zinc with casein. I have been informed that milk and cream which were allowed to stand in such vessels, have given rise to nausea and vomiting. This practice would not be allowed under a proper system of medical police.

OXIDE OF ZINC.—This substance is not very active, but when taken for a long continuance, it may produce serious symptoms. The following singular case of slow poisoning by the oxide is reported in the Brit. and For. Med. Rev. No. 11, p. 221. A man, aged forty-five, wishing to treat himself for epilepsy, took twenty grains of oxide of zinc daily, until he had taken the enormous quantity of three thousand two hundred and forty-six grains. He was then seen by a physician; he was considerably emaciated,—his bowels constipated, the extremities cold, the legs œdematous, the abdomen tumid, the skin dry—and the pulse slow and scarcely perceptible. Under proper treatment he recovered. This substance is known by its becoming of a yellow colour when heated, and by its ready solubility in diluted acids with the action of the tests for zinc.

POISONING BY SILVER. NITRATE OF SILVER. (LUNAR CAUSTIC.)—This substance, which is commonly met with in small sticks of a white or dark grey colour, is readily soluble in distilled water. It acts as a powerful corrosive, destroying all the organic tissues with which it comes in contact. There are at least two cases on record, in which it has proved fatal in the human subject:—one of these occurred in 1837-8. The particulars are unknown. The TREATMENT consists in the administration of common salt.

CHEMICAL ANALYSIS.—The *solution* in water is commonly acid. A slip of copper introduced into a small quantity, precipitates metallic silver. 2. Muriatic acid throws down a white clotted precipitate of chloride of silver, insoluble in nitric acid, but soluble in ammonia and the hyposulphites. 3. Arsenite of ammonia gives a yellow precipitate. 4. Sulphuretted hydrogen, and the hydrosulphuret of ammonia, a black precipitate. 5. The nitric acid is discovered by adding carbonate of potash, when the filtered liquid will be found to contain nitre.

POISONING BY IRON.—It seems that, although the oxide and carbonate of this metal, may be given in very large quantity, without any serious effects resulting, yet some of its preparations act as irritants.

SULPHATE OF IRON. (COPPERAS. GREEN VITRIOL.)—One death from this substance took place in 1837-8. It has been several times administered with malicious intention. It cannot, however, be a very active preparation; for a girl who swallowed an ounce of it, recovered, although she suffered for some hours from violent pain, vomiting and purging.

A singular case, which seems to show that this substance may really act through the skin, has been lately reported by Mr. Moore, of York. A healthy boy, aged fourteen, after having been employed in picking crystals from the vat, in which sulphate of iron was set to crystallize, was attacked with headache and sickness. He vomited several times, felt pains in the calves of his legs, and colicky pains in the abdomen. At the same time, his limbs became contracted. The boy had previously complained that the liquor of the crystals, into which he was constantly dipping his hands, had cracked his fingers. In the course of a week or ten days, these symptoms disappeared under treatment. (Med. Gaz. xxx. p. 351.) No other cause could be assigned for this singular attack, than the frequent contact of the hands with the saturated solution of the green sulphate of iron. I have known a similar dryness and cracking of the skin of the hands, produced by contact with a strong solution of sulphate of copper; and it is stated by Dr. Christison, that the dyers of Glasgow were attacked at one time, with troublesome sores on the hands, from the frequent immersion of them in a solution of bichromate of potash.

CHEMICAL ANALYSIS.—This substance is generally met with in crystals of a sea-green colour. It is readily soluble in water. 1. Ferrocyanate of potash added to the solution, gives a blueish precipitate, becoming of a deep blue by exposure to the air. 2. Sulphocyanate of potash gives a reddish precipitate, which after a short exposure to the air becomes of a deep blood-red colour. 3. Hydrosulphuret of ammonia gives a black precipitate. 4. Nitrate of barytes will show the presence of sulphuric acid.

MURIATE OF IRON. TINCTURE OF SESQUICHLORIDE OF IRON.—This is an acid solution of peroxide of iron with alcohol, of a red colour, much used in medicine. Dr. Christison relates an instance, where a man, by mistake, swallowed one ounce and a half of this liquid:—the symptoms were somewhat like those produced by muriatic acid. He died in about five weeks,—the stomach was found partially inflamed and thickened towards the pylorus. A case was reported to the Westminster Medical Society in November, 1842, where a girl, aged 15, five months advanced in pregnancy, swallowed an ounce of the tincture of muriate of iron in four doses in one day, for the purpose of inducing abortion. Great irritation of the whole urinary system followed, but this was speedily removed, and she recovered.

CHEMICAL ANALYSIS.—The iron may be detected by the tests above-mentioned,—the muriatic acid by the use of nitrate of silver.

POISONING BY BISMUTH. SUBNITRATE OF BISMUTH.—This substance, in a dose of two drachms, caused the death of an adult in nine days. There was burning pain in the throat, with vomiting and diarrhea,—coldness of the surface, and spasms of the extremities,—also a strong metallic taste in the mouth. On inspection, the fauces, larynx and œsophagus were found inflamed; and there was inflammatory redness in the stomach and throughout the intestinal canal. (Sobernheim, 335.) This case affords another proof that a substance very slightly soluble in water, may exert a powerfully poisonous action on the human system.

CHEMICAL ANALYSIS.—This substance is commonly seen under the form of a white powder, or occasionally in semitransparent pearly crystals. The powder is blackened by hydrosulphuret of ammonia, in which respect it resembles a salt of lead. It is turned of a yellow passing to a deep chocolate brown, with iodide of potassium. It is scarcely soluble in water, but readily dissolves in nitric acid, and when this solution is added to a very large quantity of water, the subnitrate, if the liquid be not too acid, is again precipitated. In this respect it resembles only chloride of antimony; but it is known from this compound by the action of sulphuretted hydrogen, or hydrosulphuret of ammonia.

POISONING BY CHROME.—The only compound of this metal which requires any notice as a poison, is the BICHROMATE OF POTASH. This salt is extensively used in the art of dyeing; and one death is reported to have occurred from it in 1837-8, but the particulars are unknown. There is no doubt that it is an irritant poison, affecting also powerfully the nervous system. In animals it has produced in small doses vomiting, diarrhea, paralysis, and death in a few hours. It appears also, like some other metallic salts, to have a local action when in a state of concentrated solution; and thus it has been observed to produce extensive sores on the hands of dyers, owing to frequent contact with the liquid.

CHEMICAL ANALYSIS.—This is an acid salt, easily known from all the other metallic poisons, by its being in crystals of a deep orange-red colour. It is readily soluble in water, and the solution has the rich orange colour of the salt. It has an acid reaction. It may be identified by the following tests: 1. The solution is precipitated of a rich red colour, by nitrate of silver. 2. Of a bright yellow, by the acetate of lead. 3. Of a dingy green, by a current of sulphuretted hydrogen gas. Potash may be discovered in it by the action of chloride of platina.

This then concludes the history of the mineral irritant poisons. Many substances considered poisonous by toxicologists, have been omitted, because as yet nothing is known of their effects on the human subject. Those bodies only have been here treated, which have either proved fatal to man, or which, from their being widely diffused in common life, are very likely to give rise to accidental poisoning.

CHAPTER XXII.

GENERAL REMARKS ON THE METHODS OF DETERMINING THE NATURE OF MINERAL POISONS. ANALYTICAL TABLES.

ONE of the most difficult problems, which a medical jurist has to solve in relation to poisons, is that which is commonly left untouched in works on toxicology; namely, what steps are to be pursued in order to determine the nature of a suspected poisonous substance. It is easy to verify, by the application of chemical tests, the nature of a mineral poison, when we know or really suspect what it is; but all who have exercised themselves in these matters must have felt the difficulty, amidst the multiplicity of tests, to make a selection and apply them in particular cases. Assuredly, if experiments of this kind be conducted at random, the whole of the suspected substance is likely to be expended without any satisfactory result being obtained. Hence the necessity arises for adopting some rules of generalization, so that not only may the trouble attending an analysis be reduced, but a result speedily attained. If the poison has been taken and caused death, the analysis may be assisted by ascertaining how soon after taking it, the symptoms occurred; their nature, the period at which the person died, and other circumstances of the like kind:—indeed it has been already observed, that these very facts may disprove the suspicion of poisoning, and render a chemical analysis wholly unnecessary. But the substance may not have been taken, and in this case we can only proceed by chemical rules. In respect to the generalizations about to be made, I must observe that they only apply to the chemical analysis of those substances, which have already been treated as poisons in the preceding chapters of this work; or otherwise it is obvious, that the whole department of mineral chemistry would require to be introduced. If any exception be made in this respect, it will be only in relation to some very common substances, which closely resemble the mineral poisons in their physical or chemical properties. After all, the great difficulty in medical jurisprudence consists not so much in distinguishing poisons from other substances, as in distinguishing them from each other; since the cases in which a chemical analysis is chiefly demanded, are those where the substance taken, has given rise either to serious symptoms or to death. Some substances in the subjoined tables may not be regarded as poisons:—that is a point which does not require to be here discussed—(see antè, p. 2)—it is sufficient for a medical jurist to know that these reputed innocent substances have actually caused death; and therefore they may again come before him for a chemical examination.

1. TABLE OF THE ACID POISONS.

	Nit. Barytes.	Nit. Silver	Sulph. Lime.
Sulphuric acid	precipitate insol. in nitric acid.		
Sulphate of Indigo ..			
Nitric acid			
Muriatic acid........	....	precipitate insol. in nitric acid.	
Nitromuriatic acid. ..	....	precipitate insol. in nitric acid.	
Nitrosulphuric acid ..	precipitate insol. in nitric acid.		
Oxalic acid..........	....	precipitate sol. in nitric acid.	precipitate sol. in nitric acid.

Nitric acid would be known by its action on copper:— nitromuriatic acid by its property of dissolving gold.

In respect to the *alkaline* poisons and their salts we may observe,—1. That they are all white solids, (some of them crystalline) except the alkaline sulphurets. 2. That the greater number are readily dissolved by water; and that the solution may have an acid, alkaline or neutral reaction with test paper. 3. That the solution or the solid diffused in water, undergoes no change when exposed to a current of sulphuretted hydrogen gas:—some of the acid salts throw down sulphur from the hydrosulphuret of ammonia, and alum gives an abundant precipitate of alumina with that test. 4. That carbonate of potash gives a white precipitate with barytes and its salts, while it does not affect potash, soda and ammonia or their salts. Lime and strontia are introduced not as poisons, but to show how they may be distinguished from barytes, for which they are very liable to be mistaken. 5. These salts are distinguished from the metallic irritants except tartar emetic, (tab. 4,) in not being precipitated by a solution of ferrocyanate of potash.

II.—TABLE OF THE ALKALINE POISONS AND THEIR SALTS.

	Water.	Reaction.	Chlor. Platina. Tartaric Acid.	Sulphuric Acid.	Oxalic Acid.	Sulph. Lime.
Potash.	soluble.	alkaline.	precip.			
Carb and Bicarb.......	sol.	alk.	precip.	efferves.	efferves.	precip.
Soda.	sol.	alk.				
Carb. and Bicarb......	sol.	alk.	....	efferves.	efferves.	precip.
Chloride Sodium......	sol.	neutral.				
Ammonia.............	sol.	alk.	precip.			
Sesquicarbonate.......	sol.	alk.	precip.	efferves.	efferves.	precip.
Iod. Potassium........	sol.	neutral.	pre. T. Acid.			
Sulphuret Potassium..	sol.	alk.	precip.	Sd. hyd. S. pr.	Sd. hyd. S. pre.	
Nitrate of Potash.	sol.	neutral.	precip.			
Bitartrate of Potash ..	sol.	acid.				
Binoxalate of Potash..	sol.	acid.	....	....	....	precip.
Alum	sol.	acid.				
Barytes	sol.	alk.	....	precip.	precip. sol.	precip.
Chlor. Barrum........	sol.	neutral.	....	precip.	....	precip.
Nitrate of Barytes	sol.	neutral.	....	precip.	....	precip.
Acetate of Barytes....	sol.	neutral.	pre. T. A. sol.	efferves.	precip. sol.	precip.
Carbonate of Barytes	insol.	....	....	efferv. ins.	efferves.	
Lime.	sol.	alk.	pre. T. A. sol.	....	precip.	
Salts of lime..........	sol.	neutral.	....	pre. if concent	precip.	
Strontia	sol.	alk.	....	precip.	precip.	
Salts of Strontia.......	sol.	alk.	....	precip.	precip.	precip.

N. B. The substances in italics are not ranked among poisons.

The metallic irritant poisons, may be divided into two groups ; those which are coloured, and those which are colourless. A slight attention to colour, will enable us to distinguish many of these bodies from each other, and by this criterion, if properly attended to, we may determine at once the steps of the analysis to be pursued. In the first place, it will be observed that the greater number of them are quite insoluble in water:—those which are soluble, have the letter *s* prefixed. Some are not at all changed in colour when treated with sulphuretted hydrogen or hydrosulphuret of ammonia,—these are marked with the letter *a:* the other coloured substances are variously affected, being generally turned brown or black. The substances printed in Italics, are not commonly ranked as poisons :—they are introduced in order that the coloured poisons may not be mistaken for other coloured substances which resemble them. The four colours are yellow, blue, green and red :—in any two substances of either colour, there is scarcely the same shade, so that when once compared, they may in general be easily distinguished.

III.—METALLIC IRRITANTS. COLOURED MINERAL POISONS.

Yellow.	Blue.	Green.	Red.
Massicot. (Oxide of lead.)	s Sulph. Copper.	Scheele's green. (Ars. Copper.)	Red Oxide Mercury
Turner's yellow. (Oxychlor. Lead.)	s Nitrate. Copper	Schweinfurth green. (Ars. and Acet. Copper.)	Nitric Oxide.
	s Ammoniuret.— Verditer.		Cinnabar.
a Orpiment.			Vermilion.
Turbith mineral.		Chloride. Copper.	
		Brunswick green. (Oxychloride.)	Litharge.
			Minium.
		s Acetate copper.	a Realgar.
		s Subacetate —	s Bichromate Pot.
Ammoniuret Iron.	*Smalt. (Ox. Cobalt.)*	Carbonate —	s Sulphuret Potassium.
Chromate of Lead.	*Prussian Blue.*	s Sulph. Iron.	
Iodide of Mercury.	*Indigo.*		
a *Persulphuret of Tin.*			*Biniodide Mercury.*
a *Sulphuret Cadmium*		*Oxide of Chrome.*	*Peroxide of Iron.*
a *Chromate of Potash.*		s *Salts of Nickel.*	*Oxysulphuret of Antimony.*
a *Ferrocyanate.—*			

The COLOURLESS metallic irritan poisons are very numerous, and it is commonly among these, that the greatest difficulty is experienced in an analysis. They may, however, be distinguished from each other by treating them with the undermentioned reagents :—but these are merely to be regarded as trial tests ; i. e. to point to the particular nature of the poison for the detection of which special tests are subsequently to be applied. The undermentioned reagents may be added either to the solids or to the solutions in water, if the mineral poison be soluble. These poisons are said to be colourless ; but some of them have a slight tint, bordering on yellow.

IV.—METALLIC IRRITANTS. COLOURLESS MINERAL POISONS.

	Heat.	Water.	Sulphuretted Hydrogen.	Hydrosulphuret of Ammon.	Potash.	Iodide of Potassium.
Arsenious acid....	volatile.	sol. with difficulty.	yellow prec.	....	soluble.	
Arsenic acid......	fixed.	very soluble.	yellow.	....	soluble.	
Corros. sublimate..	volatile.	soluble.	black.	black.	orange yellow prec.	scarlet precip.
Calomel	volatile.	insoluble.	black.	black.	black.	green yellow.
White precipitate.	volatile.	insoluble.	black.	black.	yellow by heat.	orange.
Nitrate mercury..	vol. decompd.	soluble.	black.	black.	black.	yellow.
Pernitrate	vol. decompd.	soluble.	black.	black.	orange yellow pre.	scarlet.
Bicyanide	vol. decompd.	soluble.	black.	black.		
Acetate Lead.	carbonized.	soluble.	black.	black.	white.	yellow.
Subacetate........	carbonized.	soluble.	black.	black.	white.	yellow.
Nitrate.	yellow decompd.	soluble.	black.	black.	white.	yellow.
Chloride	melts (fixed.)	soluble.	black.	black.	white.	yellow.
Sulphate	fixed.	insoluble.	black.	black.	....	yellow by heat .
Carbonate	orange.	insoluble.	black.	black.	....	yellow.
Tartar emetic.....	carbonized.	soluble.	orange red.	orange red.	white p. sol.	
Chloride of Tin. ..	fixed.	soluble.	black.	black.	white p. sol.	
Dyer's Spirit......	fixed.	soluble.	yellow.	yellow.	white p. sol.	
Sulphate of Zinc ..	fixed.	soluble.	white.	white.	white p. sol.	
Carbonate	yellow.	insoluble.				
Acetate	carbonized	soluble	white.	white.	white p. sol.	
Oxide	yellow.	insoluble.				
Nitrate of silver ..	fixed (melts.)	soluble.	black.	black.	brown.	yellow, white.
Subnit. Bismuth ..	yellow (fixed)	insoluble.	black.	black.	....	brown.

It is impossible, in giving a summary of this kind, to represent the slight differences in respect to solubility and the colours produced by the various reagents; but these it is not difficult for one, moderately acquainted with chemistry, to appreciate.

There are four states in which a poison may be presented for analysis: 1, solid and unmixed with other substances; 2, pure and in solution in water. It is anticipated that the preceding tables will enable a medical witness to determine, without much difficulty, the nature of the substance he is examining. It may not happen to be a poison: then the discovery of its nature must depend on his general knowledge of chemistry.

There are two other states in which a poisonous substance may require to be analysed: 3, solid and mixed with organic solids, as arsenic in powdered coffee; and 4, dissolved or suspended in liquids containing organic matter, as corrosive sublimate in wine, porter, beer, or milk. The last is a condition very frequently requiring investigation: — the third state merges in the fourth; since we are in general compelled to boil the poisoned solid in water, in order to ascertain its probable nature. Alcohol or ether may be occasionally substituted for water; in one case they may serve to remove the poison from the organic matter, and in another, dissolve the organic matter and leave the poison. Let us, however, assume that the poison is dissolved in an organic liquid:—all its physical properties are lost, and we can now trust to chemical reagents alone. With regard to the soluble salts of copper, they never exist in an organic liquid in a far less than poisonous proportion, without giving to the liquid a decidedly blueish or greenish colour, by which character, therefore, a liquid containing a soluble cupreous poison, may be commonly known. In order to distinguish the principal metallic poisons, we employ sulphuretted hydrogen gas: if we except arsenic, all the metallic poisonous solutions are similarly precipitated by hydrosulphuret of ammonia. The colour of the precipitate is different for different metals; and it is in this way we derive an inference of the kind of metallic poison present.

V.—METALLIC IRRITANT POISONS. ACTION OF A CURRENT OF SULPHURETTED HYDROGEN GAS, OR OF HYDROSULPHURET OF AMMONIA, UPON THEIR SOLUTIONS.

Yellow.	Orange Red.	Black or Brown.	White.	Green.
Arsenic (S.H.) Dyer's Spirit. Permur. Tin.)	Salts of Antimony. Tartar Emetic.	Lead. Copper. Mercury. Bismuth. Proto. Chlor. Tin. Green Sulph Iron. (Copperas) (H.S.A.) Nit. Silver.	Salts of Zinc.	Bichromate of Potash.
Salts of Cadmium.		*Nickel (H.S.A.)* *Cobalt. (H.S.A.)* *Tellurium.* *Uranium.*		*Chromate of Potash.*

A convenient way of testing an organic liquid, is to dip into it a slip of bibulous paper, and then expose this to a current of the gas produced in a tube; we thus get rid of the effect of colouring matter, but this will only answer, where the quantity of poison dissolved, is moderately large. When there is no change of colour in the slip of paper under these circumstances, we may filter off one-fourth of the liquid, neutralize it by potash or acetic acid, according to whether it be acid or alkaline, and then pass into it from a retort or bottle, a current of the gas. If the change of colour be not apparent in the liquid, it will be often perceptible in the froth or scum, which will readily assume a colour according to the nature of the metallic substance present. If the paper or froth should be turned of a *yellow* colour,—it may be owing to the presence of arsenic, cadmium, or tin. For obvious reasons, the presumption is generally in favour of arsenic ;—a fact which will be apparent by the golden-yellow colour of the paper being immediately discharged by dipping it into a strong solution of ammonia. Should the yellow colour be produced by tin or cadmium, the organic liquid will be equally precipitated by hydrosulphuret of ammonia. The yellow stain of arsenic is dissolved by ammonia, and not by strong muriatic acid, that of cadmium is dissolved by muriatic acid, and not by ammonia—that of tin is not readily dissolved by either: but arsenic would be at once known by boiling a portion of the liquid with muriatic acid and metallic copper.

If the slip of paper acquire a *black* or *brown* colour,—although there are many metals thus affected, the presumption is always in favour of lead or mercury :—in the former case, the colour is instantaneously produced by the gas, in the latter (corrosive sublimate) slowly. The salts of copper would be indicated by the green tint of the liquid, and by the introduction of polished iron. It is very unlikely that any of the other metals should be present;—and with respect to the soluble salts of mercury and lead,—the last are known from the first by the organic liquid being abundantly precipitated by dilute sulphuric acid. The galvanic test either of gold and zinc, or of zinc and platina, may be also applied. When zinc is present no effect is produced on the slip of paper; and it is then necessary to pass a current of gas into a portion of the liquid,—the milky whiteness of the froth will indicate zinc. Antimony is peculiar in producing an orange-red colour, which is removable by caustic potash and strong muriatic acid, but not readily by ammonia. When we have by these experiments determined the probable nature of the poison, we may pursue the process recommended for the particular metal in a state of mixture with organic substances.

If sulphuretted hydrogen gas should produce in a neutralized and concentrated liquid no perceptible change, the poison, if any, may belong to those mentioned in tables I. and II. If none of these be present; and there is no effect when the liquid is much concentrated by evaporation, there is probably not sufficient of the metallic poison present, to allow of its separation and identification. There are some exceptions to this remark; as in the case of arsenic and antimony, which may be still detected by Marsh's or Reinsch's test,—of mercury, by gold and zinc, of copper by iron, where sulphuretted hydrogen gas, either produces no change at all, or the change is of an equivocal character.

There are certain poisonous substances of an irritant nature, which belong to the vegetable kingdom. These are very numerous as a class; but it will be necessary to notice only those which have either caused death, or given rise to medico-legal investigations. They may be appropriately considered under the name of vegetable irritants.

CHAPTER XXIII.

ON POISONING BY THE VEGETABLE IRRITANTS.

Aloes. Colocynth. Gamboge. Jalap and Scammony.—These different substances which are used in small doses as medicines, are liable when taken in large quantities, to give rise to vomiting, purging, and other symptoms of irritation. Colocynth has occasioned death in several instances, and aloes and colocynth mixed, are said to be the basis of a certain quack medicine sold under the name of Morison's Pills. These have proved fatal in many instances from the exhaustion produced by excessive purging, owing to the large quantity of these pills, taken in frequently repeated doses. Our knowledge of the symptoms and post-mortem appearances produced by these irritants, is, indeed, chiefly derived from the cases which have proved fatal under this pernicious treatment. In the seventeenth volume of the Medical Gazette, will be found four cases of this description. The most prominent symptom is excessive diarrhea, with the discharge of large quantities of mucus; the individual becomes emaciated and slowly sinks. In some instances, the symptoms are those of inflammation and ulceration of the bowels. In 1836, a man was convicted of having caused the death of a person by the administration of these pills; in this instance, the death of the deceased was clearly due to the medicine; and on inspection, the stomach was found inflamed and ulcerated; the mucous membrane of the small intestines was injected, softened, and there was the appearance of effused lymph upon it. An ingenious attempt was made in the defence to draw a statement from the medical witness, that the good effects of some medicines, increased in proportion to the quantities taken; this was very properly denied. In all cases, it must be remembered, that these drastic purgatives may cause serious symptoms or even death, when administered to young infants, or to persons debilitated by age or disease; nor is it necessary that the dose should be very large for the effect to follow. The questions here, will be whether the medicine caused death, or whether it simply accelerated it.

Hicrapicra appears to be a popular aloetic compound, and one death is recorded to have been produced by this in 1837-8. In another instance, death was caused by taking aloes in nitric acid, in which case the mineral acid was most probably the destructive agent. A singular case occurred in Germany a few years since, wherein a medico-legal question was raised as to the poisonous properties of aloes. A woman, aged forty-three, not labouring under any apparent disease, swallowed two drachms of powdered aloes in coffee. Violent diarrhea supervened, and she died the following morning, twelve hours after having taken the aloes. On inspection, the stomach was found partially, and the small intestines extensively, inflamed. There were no other particular appearances to account for death, and this was referred to the effect of the aloes.

Savin. (Juniperus Sabina.)—This is a well-known plant, the leaves of which appear to contain an irritant poison. They exert an irritant action, both in the state of infusion and powder. They also yield by distillation a light yellow oil on which the irritant properties of the plant appear to depend. This substance is not often taken as a poison for the specific purpose of destroying life; but this is occasionally an indirect result of its use, as a popular means for procuring abortion. In this way it appears to have proved fatal in one case in 1837-8. From the little that is known of its effects, it acts by producing violent pain in the abdomen and vomiting. After death, the viscera have been found much inflamed. It has no action as an abortive, except like other irritants, by causing a violent shock to the system, under which the uterus expels its contents. Such a result can never be obtained without placing in jeopardy the life of the woman; and where abortion follows, she generally falls a victim. On the other hand, the female is often killed without abortion taking place.

Croton oil.—This is an oil extracted from the seeds of the croton tiglium. It is a powerful drastic purgative, producing in a large dose severe diarrhea, collapse, and death. A case occurred in Paris in 1839, where a man swallowed by mistake two drachms and a-half of croton-oil. In three quarters of an hour the surface was cold and clammy, the pulse imperceptible, respiration difficult, and the extremities and face were as blue as in the collapsed stage of cholera. In an hour and a-half diarrhea set in; the stools were passed involuntarily and the abdomen was very sensitive to the touch. The patient complained of a burning pain in the course of the œsophagus. He died in four hours after swallowing the poison. There was no marked change in the mucous membrane of the stomach.

Judging from the following case, which is rather one of veterinary than of medical jurisprudence, this oil appears to be an active poison. A veterinary surgeon administered as a medicine, fifteen drops to a horse. The lips of the animal became swollen, and the skin peeled off; the horse suffered evidently great pain, and after lingering a short time died. An action was brought by the owner of the horse at the Oxford Aut. Cir. 1838, for the recovery of its value. From the evidence then given, it seemed probable that the animal had really died from a very small dose of the oil, although it was thought that more was given, than was here alleged to have caused death.

Castor oil seeds.—Of castor oil itself nothing need be said. It is not commonly known that the seeds from which this oil is extracted, are a very active poison, and that a few of them are sufficient to produce violent purging and death. The following is an instance of poisoning by these seeds, the only one with which I have met. The deceased was the sister of a gentleman who was at the time attending my lectures at Guy's Hospital.

The deceased, it appears, ate about twenty castor-oil seeds; one of her sisters ate four or five, and another, two. This was on a Wednesday evening. In the night they were all taken ill. About five hours after the seeds were eaten, the deceased felt faint and sick; vomiting and purging came on, and continued through the night. On the following morning, she appeared like one affected with malignant cholera. The skin was cold and dark-coloured, the features contracted, and the breath cold; the pulse was small and wiry; there was restlessness, thirst, pain in the abdomen, and she lay in a sort of drowsy, half-conscious state. Whatever liquid was taken, was immediately rejected, and the matters passed by stool, consisted chiefly of a serous fluid tinged with blood. She died in five days without rallying; the two other sisters recovered. On inspection, a very large portion of the mucous membrane of the stomach, was found abraded and softened in the course of the greater curvature. There was general vascularity of the organ, and the abraded portion presented the appearance of a granulating surface of a pale rose-colour; it was covered by a considerable quantity of slimy mucus. The small intestines were inflamed, and the inner surface of them was abraded.

It is difficult to say on what this irritant poisonous property depends, since the oil is a mild purgative, and the quantity yielded by twenty seeds would certainly have caused no mischief. The effects produced on the sisters who recovered, bear out the statement of Dr. Christison, that two or three of these seeds will operate as a violent cathartic.

BERRIES AND LEAVES OF THE YEW-TREE. (TAXUS BACCATA.) It has been long known, that the berries and leaves of the yew-tree are poisonous to cattle;—that they act very energetically, and produce death speedily. Perhaps, with propriety, this should be considered rather as belonging to the narcotico-irritant, than to the irritant class of poisons. It is stated by Dr. Percival that a table-spoonful of the fresh leaves was administered to three children of five, four, and three years of age as a vermifuge. Yawning and listlessness soon succeeded; the eldest vomited a little, and complained of pain in the abdomen, but the other two suffered no pain. They all died within a few hours of each other. An interesting case of poisoning by the berries of this tree, was published a few years since by Mr. Hurt, of Mansfield. A child aged three years and a-half, ate a quantity of yew-berries about eleven o'clock. In an hour afterwards, the child appeared ill, but did not complain of any pain. It vomited part of its dinner, mixed with some of the berries. A medical man was sent for, but the child died in convulsions before he arrived. On inspection, the stomach was found filled with mucus, and the half-digested pulp of the berries and seeds. There were patches of redness in the mucous membrane, and this was so much softened, that it could be detached with the slightest friction. The small intestines were also inflamed. It is uncertain whether the poison is lodged in the pulp of the berry or in the seed; but most probably in the latter.

Dr. Christison states that the leaves and flowers of the common elder (SAMBUCUS NIGRA) act as an irritant poison, having caused in a boy, severe inflammation of the bowels which lasted for eight days. (Ed. Med. and Sur. Jour. xxxiii. 73.) The berries of this tree do not appear to possess, in the ripe state, any noxious properties.

CAYENNE PEPPER is reported to have proved fatal in one case in 1837–8. The particulars are unknown. There is no doubt that in a large dose it would irritate and inflame the mucous membrane of the stomach and bowels.

OIL OF TAR.—This is a powerful vegetable irritant. In 1832, about ten drachms of it caused the death of a gentleman, to whom it had been sent by mistake for a black draught. The party who sent it was tried for manslaughter, but acquitted.

Other vegetable irritants might be enumerated, but I believe these are the principal which have given rise to medico-legal inquiries. The treatment of such cases must depend on the nature of the symptoms; the main object should always be to remove the poison either from the stomach or bowels, with as little delay as possible. The nature of the poison is commonly apparent from the circumstances; for these cases are generally the result of accident, if we except the substance Savin, which is sometimes criminally administered. These poisons are beyond the reach of chemical processes:—they are only to be recognized either by their physical properties, or by the botanical characters of the berries, seeds, or leaves.

CHAPTER XXIV.

ON POISONING BY THE ANIMAL IRRITANTS.

THERE are certain irritant substances belonging to the animal kingdom, which here require to be noticed, since they sometimes give rise to questions of poisoning. It is unnecessary to say anything about the poison of hydrophobia, or of the venomous reptiles and insects; since these subjects do not fall within the scope of the present work. The first and most important of the animal irritants is the blistering fly.

CANTHARIDES.—This poison has been frequently administered either in the state of powder or tincture, for the purpose of exciting aphrodisiac propensities, or of procuring abortion. When taken in the state of powder, and in the dose of one or two drachms, it gives rise to the following SYMPTOMS. A burning sensation in the throat, with great difficulty of swallowing,—violent pain in the abdomen with nausea and vomiting of bloody mucus;—there is also great thirst and dryness of the fauces, but in a few cases observed by Mr. Maxwell, salivation was a prominent symptom. As the case proceeds, pain is commonly experienced in the loins, and there is incessant desire to void urine, but only a small quantity of blood or bloody urine is passed at each effort. The abdominal pain becomes of the most violent griping kind. Diarrhea supervenes, but this is not always observed:—the matters discharged from the bowels, are mixed with blood and mucus. In these as well as in the vomited liquids shining green particles may be commonly seen on examination, thereby indicating the nature of the poison taken. After a time, there is often severe priapism, and the genital organs are swollen and inflamed both in the male and female. In one instance, observed by Dr. Pereira, abortion was induced, probably owing to the excitement of the uterus, from the severe affection of the bladder. Whether this substance acts directly on the uterus to induce abortion, is a doubtful point. With respect to the aphrodisiac propensities caused by cantharides,—these can seldom be excited on either sex, except when administered in a dose which would seriously endanger life. When the case proves fatal, death is usually preceded by syncope, vertigo and convulsions. The tincture of cantharides produces similar symptoms:—they are, however, more speedily induced, and the burning sensation and constriction of the throat and stomach are more strongly marked: it is often so severe as to render it impossible for the individual to swallow; and the act of swallowing gives rise to the most excruciating pain in the throat and abdomen. POST-MORTEM APPEARANCES. In one well-marked case of poisoning by this substance, the whole of the alimentary canal from the mouth downwards, was in a state of inflammation, as well as the ureters, kidneys, and internal organs of generation. The mouth and tongue seemed to be deprived of their mucous membrane. In another instance, where an ounce of the tincture was swallowed, and death did not occur for fourteen days,—the mucous membrane of the stomach was not inflamed; but it was pulpy and easily detached. The kidneys were, however, inflamed. The brain has been found congested, and ulceration of the bladder is said to have been met with. There are very few fatal cases reported, in which the appearances have been accurately noted; indeed, the greater number of those who have taken this poison, have recovered. Cantharides are sometimes described as a corrosive poison; but the substance appears to have no local action of a chemical nature. It is a pure irritant, and the effects observed are entirely due to irritation and inflammation.

The *quantity* of this poison, required to produce serious effects, or to destroy life, has been a frequent subject of medico-legal inquiry. Thomson represents the medicinal dose of the powder to be from one to three grains. On a late criminal investigation one medical witness stated, that one grain was the maximum dose, but this is an understatement; according to Thomson it is *three* grains:—the dose of the London Pharmacopœial tincture is from ten minims gradually increased to one fluid drachm. Doses above this, whether of the powder or the tincture, are likely to be injurious, and to give rise to symptoms of poisoning. On a trial which took place at Aberdeen, in 1825, it appeared that a drachm of the powder had been administered: severe symptoms followed, but the person recovered. Dr. Dyce, the medical witness, said he had given ten grains of the powder at a dose as a medicine. In three cases, observed by Mr. Maxwell, a drachm of the powder mixed with six ounces of rum was taken by each person: they were robust, healthy negroes,—they suffered severely, but recovered in about ten days:—in these cases, irritation of the urinary organs did not appear until after the men had been bled. The smallest quantity of powder which has been known to destroy life, is in the case of a young female, quoted by Orfila,—the quantity taken was estimated at twenty-four grains in two doses. She died in four days, but as abortion preceded death, it is difficult to say how far this may have been concerned in accelerating that event. Her intellect was clear until the last.

An ounce of the tincture has been known to destroy life. It was taken by a boy, aged seventeen, and he died in fourteen days. This I believe is the smallest dose of the tincture which has killed. In the following instance a similar dose produced only serious symptoms. A woman, aged twenty-nine, swallowed an ounce of tincture of cantharides. Some time afterwards, there was severe pain in the abdomen, increased by pressure: it became swollen and tympanitic. She passed in the night a pint and a half of urine unmixed with blood. In two days, the pulse became feeble and scarcely perceptible:—there was delirium and severe pain in the region of the kidneys and bladder:—the urine was continually drawn off by a catheter. It was more than a fortnight before she was convalescent. (Med. Gaz. xxix. 63.) Four drachms and even six drachms have been taken; and although the usual symptoms followed, the parties did well. The last case was the subject of a trial at the Central Criminal Court, in September 1836. Six drachms of the tincture were administered to a girl, aged seventeen: the medical witness was required to say whether half an ounce was sufficient to kill, as also what proportion of cantharides was contained in an ounce of the tincture,—he said five grains. This is a point, which I do not think is satisfactorily settled; and, considering that the principle cantharidine is the substance on which the poisonous properties depend, it is very likely that the tincture varies in strength according to its mode of preparation. A case is quoted by Pereira, in which it is said, six ounces of the tincture were taken by a man without causing dangerous symptoms. This must have been an extraordinarily weak preparation: and probably the insects from which the tincture was made, contained little or no cantharidine.

Cantharides are sometimes taken in the form of blistering plaster. A case was lately reported to the Westminster Medical Society, in which a woman took a piece about the size of a walnut, in chocolate by mistake. In about an hour, vomiting and strangury supervened this was followed by inflammation of the kidney. The woman speedily recovered.

It is proper to state that cantharides will operate as a poison, when applied externally to a wound or ulcerated surface. This substance will also act with fatal effects, when applied to a large surface of skin. In January, 1841, a girl, aged sixteen, was killed at Windsor, under the following circumstances. She was affected with the itch,—sulphur ointment was prescribed for her, but by mistake, blistering ointment was given. This was rubbed all over the body of the girl :—she was soon seized with the most violent burning pain,—the ointment was immediately washed off, but the cuticle came off with it. The girl died in five days, having suffered from all the usual symptoms of poisoning by cantharides.

Treatment.—When vomiting exists, this may be promoted by demulcent liquids : if it does not exist, emetics should be given,—the object being to dislodge the poison. The state of the throat will scarcely admit of the application of the stomach-pump. Oil was formerly regarded as an antidote ;—but it has been found that this is a ready solvent of the active principle, and is therefore injurious.

Chemical analysis.—Cantharidine is the vesicating, and at the same time the poisonous principle of the insect. It is a white solid crystallizable substance, insoluble in water ; but soluble in ether, alcohol, the oils and caustic alkalies. Although water does not dissolve it in its pure state, it takes it up with other principles, from the powdered insect ; and thus an infusion of cantharides is poisonous. It is very volatile and produces serious effects in the state of vapour. There are no chemical characters by which this principle can be safely identified, if we except its vesicating properties. Orfila has applied reagents to detect cantharidine in the tincture ; but without success. It has been recommended to digest the suspected solid, or the liquid contents of the stomach evaporated to an extract, in successive quantities of ether,—to concentrate these ethereal solutions by slow evaporation, and then observe, whether the concentrated liquid produces vesication or not :—the medical jurist being expected in such cases, to make himself the subject of experiment. In this way, Barruel discovered cantharides in some chocolate. (Ann. d'Hyg. 1835. 455.) This mode of testing is somewhat uncertain, unless the quantity of poison be large ; and the affirmative evidence which it yields is better than the negative : since we can hardly infer the absence of the poison, when we obtain no result. There is, however, no other mode of discovering cantharides in solution whether as tincture or infusion than this. The difficulty of extracting this principle may be conceived, when it is stated that, according to Thierry's experiments, which are the most perfect, the quantity of cantharidine contained in the poison is only about the 250th part of tho weight of the fly, so that it requires about half an ounce of the powder to yield one grain of cantharidine. The quantity required to produce vesication is unknown, but it is extremely small. Cantharides are most commonly taken in powder, and then we may easily recognize the poison by its physical characters. If the insect be entire or only coarsely powdered, there can be no doubt of its nature. However finely reduced, the powder is observed to present by reflected light, small golden green or copper-coloured scales. These are perceptible to the eye, and are very distinct under a common lens. It has been recommended to separate the particles of cantharides, by suspending the liquid or other contents of the stomach in warm water, when the insoluble powder will subside, and they may be collected and dried for examination. In an elaborate essay on this subject, (Ann. d'Hyg. Oct. 1842,) M. Poumet recommends that the suspected liquids, mixed with alcohol, should be spread on sheets of glass and allowed to evaporate spontaneously to dryness.—The shining scales will then be seen, on examining by reflected light either or both surfaces of the glass. He has found that the particles, adhering to the mucous membrane of the stomach or intestines, might be easily detected by inflating the viscus, and allowing it to become dry in the distended state, taking care to attach to it a heavy weight, so that in drying all the folds of the mucous membrane may disappear. On cutting the dried membrane and opening it on a flat surface, the shining scales are perceptible. Physical evidence of this kind would not be of much avail for medico-legal purposes, unless there were concomitant evidence from symptoms and post-mortem appearances. In trials for administering, the analysis might be confined to the article administered; and the physical test is then applicable, since the powder is commonly given in very large quantity. There are many insects besides cantharides, which have wings of a golden green colour, and are not poisonous: yet such insects are not likely to be found in the state of powder in the stomach. Mr. Poumet states that there are some cantharides which contain no cantharidine.

The evidence of the presence of cantharides, or of their having been taken, is necessary to support a criminal charge; for, however unambiguous the symptoms produced by this poison may appear to be in its peculiar effects on the generative and urinary apparatus, the medical jurist should be aware that similar symptoms may proceed from disease. An important case of this kind has been published by Dr. Hastings. (Med. Gaz. xii. 431.) A young lady was suddenly seized with vomiting, thirst, pain in the loins, strangury and considerable discharge of blood from the urethra: the generative organs were swollen and painful. She died in four days. She was governess in a family, and there was some suspicion that she had been poisoned by cantharides. The stomach and the kidneys were found inflamed, and the bladder also: this contained about two ounces of blood. There was no trace of poison; and indeed it was pretty certain from the general evidence, that none could have been taken.

Particles of cantharides may be detected in the viscera long after interment. Orfila has detected them after a period of nine months, so that they do not seem to be affected by the decomposition of the body.

POISONOUS FOOD.—Certain kinds of animal food are found to produce occasionally symptoms, resembling those of irritant poisoning. In some cases this poisonous effect appears to be due to idiosyncrasy; for only one person out of several may be affected. These cases are of some importance to a medical jurist, since they are very likely to give rise to accusations of criminal poisoning. In the absence of any demonstrable poison, we may test the question of idiosyncrasy by observing whether more than one person is affected, and whether the same kind of food, given to animals, produces symptoms of poisoning; if, with this latter condition, several persons are affected simultaneously, we cannot refer the effects to idiosyncrasy; they are most probably due to the presence of an animal poison. Among the articles of food which have given rise to symptoms of poisoning, we may first mention,

POISONOUS FISH. MUSCLES. SALMON.—Of all the varieties of shell-fish, none have so frequently given rise to accidents as the common muscle. The symptoms which it produces, are uneasiness and sense of weight in the epigastrium, sensation of numbness in the extremities, heat, and constriction in the mouth and throat; thirst, rigors, difficulty of breathing, cramps in the legs, swelling and inflammation of the eyelids, with a profuse secretion of tears, and heat and itching of the skin, accompanied by an eruption resembling urticaria.

The symptoms are sometimes accompanied by vomiting, colic, and diarrhea. They may occur within ten minutes or, a quarter of an hour; but their appearance has been protracted for twenty-four hours. There is generally great debility. These symptoms have proceeded from the eating of not more than ten or twelve muscles. Two cases, reported by Christison, proved fatal, the one in three, and the other in about seven hours. In general, however, especially where there is free vomiting, the patients recover. In the inspection of the two above-named fatal cases, no appearance was found to account for death. The treatment consists in the free exhibition of emetics.

The poisonous action of muscles can neither be referred to putrefaction nor disease; nor in all cases to idiosyncrasy, since sometimes those muscles only have been poisonous which were taken from a particular spot; all persons who partook of them suffered, and a dog was killed to which some of them were given. From a case which occurred lately to M. Bouchardat, it would appear that copper is sometimes the cause of the poisonous effects. Two women were poisoned by muscles, and he found on analysis sufficient copper in them to account for the symptoms of irritation from which they suffered. (Ann. d'Hyg. 1837, 358.) Copper is not, however, present in all cases, and it is therefore probable that there is in some, if not in all instances, an animal poison present in the fish. *Oysters* and *periwinkles* have occasionally given rise to similar symptoms. *Salmon* sold in the state of pickled salmon, may also act as an irritant; this may be due to the fish being partially decayed before it is used. In 1834, two persons at Maidstone lost their lives from eating salmon of this description.

CHEESE. SAUSAGES.—These articles of food have frequently given rise to symptoms of poisoning in Germany, but there is, I believe, no instance of their having proved fatal in England. The symptoms produced by cheese, have been those of irritant poisoning. The nature of the poison is unknown. In some cases the poisonous property is undoubtedly due to a putrefied state of the curd. Again, it has been supposed, that the poison may be derived from some vegetables on which the cows feed. The symptoms, caused by the sausage-poison, are very slow in appearing; sometimes two, three, or four days elapse, before they manifest themselves—they partake more of the narcotico-irritant character. This poison is of a very formidable kind. In the Medical Gazette for Nov. 1842, there is an account of the cases of three persons, who had died from the effects of liver sausages, which had been made from an apparently healthy pig, slaughtered only a week before. The inspection threw no light on the cause of death. The poisonous effect is supposed to depend on a partial decomposition of the fatty parts of the sausages. It is said, that when extremely putrefied, they possess no poisonous properties.

PORK. BACON.—These common articles of food occasionally give rise to symptoms so closely resembling those of irritant poisoning, as to be easily mistaken for them. In some cases, the effect appears to be due to idiosyncrasy; but in others, it can only be explained, by supposing the food to have a directly poisonous action. The noxious effects of pork have been particularly shown by the cases published by Dr. MacDivitt. (Ed. Med. & Sur. Jour. Oct. 1836.) The difficulties attending these investigations will be best illustrated by the following case.

A young man accused a woman, with whom he cohabited, and her mother, of having administered poison to him in tea, which he had taken three hours previously. When seen by a medical man, there was acute burning pain in the epigastrium, with constant vomiting of a dark coloured liquid, containing half-digested food; there was a dry burning sensation in the throat,—the pulse was weak and faltering,—the extremities cold, and a cold perspiration covered the face and hands. The accused were women of bad character, and it was thought that the symptoms were caused by poison; it was found, however, that they were really owing to some pork which the man had eaten at dinner, and by the administration of emetics and purgatives they disappeared. The women had partaken of the same food without being affected; this, then, appears to have been a case in which the effects were due to idiosyncrasy. Five cases, precisely similar, are reported. In no instance, did death ensue, nor could anything peculiar be discovered in the physical properties of the food. The symptoms were observed to come on in from three to thirty hours after a meal, and the poisonous properties, if they may be so called, appeared to reside in the fatty parts of the pork.

With respect to *bacon*, instances of its exciting an irritant action are very rare; nevertheless, there seems to be no doubt that it may cause violent pain, vomiting, diarrhea, and even death. One fatal case occurred in this metropolis, in December 1836, and from the effects produced, many supposed that the bacon must have become accidentally impregnated with arsenic. There did not appear to be any ground for this opinion. Meat of any kind newly killed or partially decayed, may cause irritant effects, and even death. Thus, *veal* has been known to destroy life. From one case that has occurred, it appears to me probable, that *mutton* may exert a deleterious action.

In the spring of 1841, the following case was referred to me from a town in Oxfordshire. Four members of a family had made their dinner in their usual health from part of a sheep, which had died from a disease then prevalent among cattle. The symptoms somewhat resembled those of irritant poisoning, accompanied by others, indicating an affection of the nervous system. One of the patients, a child, died in less than three hours, the others recovered. There was no poison discovered in the food, nor in the body, nor was any poisonous vegetable used at the meal. The effects could only be explained by supposing, that an animal irritant poison was in some unknown manner generated in the food. (Guy's Hospital Reports, April 1843.)

There is no doubt that epizootic disease may be a frequent cause of rendering animal food poisonous. Partial decay may also render unwholesome and injurious, the flesh of the most healthy animal. What the nature of the poison is, we are quite unable to determine. Liebig imagines that it is owing to the production of a fermenting principle, and that it operates fatally by inducing a kind of fermentation in the animal body. It has been said that the symptoms of irritant poisoning, produced by animal food, seldom appear until five or six hours after the meal. This may be generally true, but in certain instances it has undoubtedly happened that the symptoms came on in from a quarter to half an hour after the taking of the noxious food.

CHAPTER XXV.

NARCOTIC POISONS. HYOSCYAMUS. LACTUCA. SOLANUM. OPIUM.

The symptoms produced by this class of poisons have been already described. (Chapter III.) They are chiefly referrible to disorder of the nervous system, indicated by vertigo, stupor, coma and convulsions. The poisons belonging to this class are very few in number. Orfila enumerates them as follows: Opium, hyoscyamus, prussic acid, lactuca, and solanum. He also considers that taxus baccata (yew) should be ranked among narcotics; but there is some difficulty in exactly defining the boundary of this class of poisons. The most important of the four narcotics are, opium and prussic acid; the others will require but a brief notice.

Hyoscyamus niger. (Henbane.)—All the parts of this plant are poisonous, but especially the roots and the seeds; the odour of the fresh cut leaves is sufficient to produce vertigo, stupor, and syncope. Accidents have arisen from the plant having been eaten by mistake. Several cases of this kind are reported by Orfila, to whom we are indebted for all that is known of the subject. (Tox. ii. 143.) The individual appears as if intoxicated, and suffers from delirium, coma or convulsions; vomiting takes place, and he recovers. Instances of this plant destroying life are very unusual. The tincture or medicinal extracts in large doses, would occasion similar symptoms. The active principle is a crystallizable body called hyoscyamine. It cannot be readily separated, nor when separated, is it easily identified by chemical characters. In poisoning by this and similar plants, the fact is usually made evident from circumstances. In a doubtful case, the botanical characters are all that we can trust to, in order to identify it.

Lactuca.—The extract of the common lettuce (lactuca sativa) is well known under the name of lactucarium, or lettuce opium. It is in masses of a brown colour with a strong opiate odour. It is said to contain morphia, and has a narcotic action. The extract of the lactuca virosa has also been found by Orfila to possess poisonous properties. There is no fatal case reported of poisoning by these substances in the human subject, so far as I have been able to ascertain.

Solanum.—The dulcamara or bitter-sweet, is a well known hedge plant. It is commonly called the woody nightshade. This plant does not appear to possess poisonous properties;—the shoots, the berries, and the extract have been taken or given in large quantities, without any serious symptoms resulting. Four ounces of the aqueous extract produced no effect on dogs. In one instance a decoction of the plant is said to have produced in a man dimness of sight, vertigo and trembling of the limbs,—symptoms which soon disappeared under slight treatment. The alkaline principle solanine, when extracted, has been observed to exert a poisonous action. Orfila found that the extract of solanum nigrum had a very feeble effect as a poison: and the fatal cases reported to have been caused by it, are perhaps properly referrible to belladonna, for which it may have been mistaken.

OPIUM.—This is a solid vegetable extract, sometimes taken in this state as a poison, but more commonly in solution in alcohol under the form of tincture. Its poisonous properties are due to the presence of the alkali, morphia, which exists in it in the state of a soluble salt, being combined with a particular acid, the meconic. Opium contains a very variable proportion of morphia—the quantity varying from two per cent. in the Bengal variety, to about nine per cent. in some varieties obtained from the East Indies. According to some, good opium will yield from ten to thirteen per cent. of morphia. Dr. Ure states that it is difficult to procure more than seven per cent. The Turkey opium contains on an average about five per cent. This difference in the quantity of morphia contained in the drug may sometimes account for certain differences observed in the effects produced by particular doses. It is said that the poisonous properties of morphia are much diminished by extraction from the drug; thus, according to the per centage just given, ten grains of opium are equivalent to about half a grain of morphia; but it is well known that ten grains of solid opium will produce a much more powerful effect than that quantity of morphia. Dr. Kelso, of Lisburn, doubts the correctness of this statement, from experiments made on himself. (Lancet, Sept. 1839.) There is no form of poisoning so frequent as that by opium and its various preparations. In two years, there were no less than one hundred and ninety-six fatal cases in England and Wales, forming nearly two-thirds of all the cases of poisoning that occur. One-seventh of these were cases of children poisoned by over-doses of opium or its compounds, and most of the others were the result of suicide or accident. This, however, forms but a small proportion of the actual number of cases; since there is no kind of poisoning, wherein recoveries are so frequent. It is not often that we hear of a trial for murder by poisoning with opium:—the drug being seldom selected by murderers except where the intended victim is a young child.

The poisonous salt of opium, meconate of morphia, is soluble both in water and alcohol.

SYMPTOMS.—The symptoms which appear when a large dose of opium or its tincture has been taken, are of a very uniform character. They consist in giddiness, drowsiness, and stupor, succeeded by perfect insensibility, the person lying motionless as if in a sound sleep. In this stage, he may be easily roused by a loud noise, and made to answer a question; but he speedily relapses into stupor. In a later stage, when coma has supervened with stertorous breathing, it will be difficult, if not impossible, to rouse him. The pulse is at first quick and irregular, and the respiration hurried; but when the individual becomes comatose, the breathing is slow and stertorous, the pulse is then slow and full. The pupils are sometimes contracted, at others dilated. From cases which I have been able to collect, contraction of the pupils is much more frequent than dilatation. The expression of the countenance is pale and ghastly. Sometimes there is vomiting or diarrhea; and if this takes place freely before stupor sets in, there is great hope of recovery. Vomiting is chiefly observed when a large dose of opium has been taken; and is perhaps due to a mechanical effect of the poison on the stomach. Nausea and vomiting often follow on recovery, and when the case proves fatal, convulsions are sometimes observed before death.

These symptoms usually commence in from half an hour to an hour after the poison has been swallowed. Sometimes they come on in a few minutes, especially in young children; and at others their appearance is protracted for a long period. As we might expect, when the drug is taken in the solid state, the symptoms are commonly more slow in appearing, than when it is dissolved in alcohol. Their appearance is also protracted if the stomach be full at the time; and it is said that intoxication has the effect of retarding them. (Christison.)

In a case reported by Mr. Semple, (May 1841,) one ounce and a half of laudanum was taken by a girl, aged nineteen. The symptoms did not appear until *an hour and a half* afterwards. There was drowsiness, but the patient was rational, and the pupils were contracted to the size of a pin's head, and did not dilate on removing the light. Under treatment the girl recovered. This is the longest case of protraction of symptoms which I have met with where the dose was large.

This question is of some importance in relation to a power on the part of the deceased of performing certain acts indicative of volition and locomotion, after having swallowed a large dose of this poison. The narcotic effects may not come on, until the deceased has had ample time to attempt suicide in some other way. In March, 1843, a gentleman committed suicide at Hammersmith; he was found suspended by a silk handkerchief; but it was shown that he had previously swallowed a large dose of laudanum. There was no doubt that he had died from hanging. In general, it must be allowed as at least possible, that a person who has taken a large quantity of this poison, may move about and perform many acts for one or two hours afterwards.

Post-mortem appearances.—In a case which proved fatal in fifteen hours, examined at Guy's Hospital, a few years since;—the vessels of the head were found unusually turgid throughout;—on the surface of the anterior part of the left hemisphere, there was an ecchymosis, apparently produced by the effusion of a few drops of blood. There were numerous bloody points on the cut surface of the brain:—there was no serum collected in the ventricles. The stomach was quite healthy. This may be taken as a fair example of the post-mortem appearances in poisoning by opium. Extravasation of blood on the brain is, however, very rarely seen,—but serous effusion in the ventricles or between the membranes, is more common. The stomach is so rarely found otherwise than in a healthy state, that the inflammatory redness said to have been met with, may be regarded as probably due to accidental causes. When tincture of opium has been taken and retained on the stomach, increased vascularity in the mucous membrane may be produced by the alcohol alone. From this account it will be seen that there is nothing but turgescence of the vessels of the brain, which can be looked upon as indicative of poisoning by opium, and even this is not always present. This condition of the brain, however, if found, can furnish no evidence of poisoning when taken alone, since it is so frequently dependent on morbid causes, in otherwise healthy subjects. Fluidity of the blood is mentioned by Christison, as a common appearance in cases of poisoning by opium.

Quantity required to destroy life. — In a case which occurred in London in 1838, a man aged forty-five, was killed by ten grains of solid opium. In another instance, a lady, aged twenty-nine, suffered from vertigo, numbness of the limbs, and other alarming symptoms, when only twenty drops of the tincture were introduced in the form of enema, i. e. about one grain of opium. The same dose had been administered for six nights previously, without any serious effects following;—it might therefore be a question, whether the drug did not, in this instance, possess an accumulative power. She continued in a state of delirium for twenty hours, and the numbness of the limbs only ceased after forty-eight hours. This was an unusually small dose to affect an adult; but Dr. Babington lately informed me of the case of a lady who had taken five grains of Dover's powder, i. e. about half a grain of opium, and who suffered from stupor and drowsiness for three days. These serious effects produced by small doses on adults, must be considered as exceptions to the rule: they appear to be due to idiosyncrasy or a peculiar susceptibility of the poisonous effects of opium in certain constitutions. It must not be forgotten, however, that they lead to one important inference in legal medicine, namely, that an adult may be killed by a dose of opium, which many, relying upon limited experience, would pronounce to be impossible. We have commonly no means of detecting or recognizing the existence of this idiosyncrasy in individuals prior to the fatal event. The smallest dose which has been known to prove fatal to an adult is described in a case communicated by Dr. Brown to Dr. Christison. Four grains and a half of opium mixed with nine grains of camphor, killed a man in nine hours with all the symptoms of narcotic poisoning. The smallest fatal dose of the tincture on an adult, which I have found recorded, is two drachms. This is a case reported by Mr. Skae, (Ed. M. and S. J., July, 1840.) The patient was a robust man, aged fifty-six;—he swallowed the tincture at ten in the evening, and died under the usual symptoms the following morning; the case thus lasting only twelve hours. One fact was ascertained by Mr. Skae, of some medico-legal importance;—that the individual rose from his bed and moved about at least two, and probably three hours, after having taken the poison, showing thereby that stupor had not supervened at that time. Opium as meconate of morphia, was detected in the stomach. In another case, in which the quantity taken was probably equally small, and ultimately proved fatal, the patient was able to converse cheerfully and readily with a neighbour two hours after she had swallowed the poison. It is, however, necessary to observe, that very large doses of the tincture have been taken without proving fatal. At St. Thomas's Hospital, a few years since, two women were brought in, who had each taken an ounce of the tincture: they both recovered. Several similar cases have occurred at Guy's Hospital. In July, 1841, a man was brought in, who had swallowed one ounce and a half of the tincture. Vomiting came on, but he was not brought to the hospital until twelve hours after he had taken the poison. The stomach-pump was applied, and he recovered. Neither the matter then vomited, nor the liquid brought off by the instrument, contained any trace of opium or of meconate of morphia, although the quantity examined amounted to six ounces. About the same time a woman was brought in, who had swallowed ten drachms of laudanum by mistake for tincture of rhubarb. Vomiting ensued, and she did well. It appears reasonable to attribute these recoveries from large doses to the spontaneous vomiting, or to the treatment employed, but this explanation will not always be applicable. A case occurred to Dr. Young, (Med. Gaz. xiv. 655,) where a young lady took an ounce of laudanum in whiskey, and recovered in five days: there was no vomiting, and the cause of the symptoms was not even suspected until she had recovered from her stupor, and confessed that she had taken the poison. The following case was privately communicated to me a few years since by one of my class. A medical student, after a hearty supper, at nine o'clock in the evening, swallowed four ounces of tincture of opium made by himself from opium procured at a respectable druggist's. He went to bed and slept until six o'clock the next morning, when he was awakened by a feeling of nausea. He then vomited freely; and, as he supposed, the whole of the contents of the stomach, smelling strongly of opium, were ejected. He perfectly recovered without feeling any other symptom than inability for muscular exertion. This is the largest dose which I have ever known to be taken without fatal consequences ensuing; and it is remarkable, that the opium should have remained so many hours on the stomach without causing serious symptoms and death.

Another circumstance connected with this subject it is important for a medical jurist to bear in mind, namely, that infants and young persons are killed by very small doses of opium; they appear to be peculiarly susceptible of the effects of the poison. Dr. Ramisch, of Prague, met with an instance of a child four months old, which was nearly killed by the administration of one grain of Dover's powder, containing the tenth part of a grain of opium;—the child suffered from stupor and other alarming symptoms. After this the following case, which occurred in June 1832, will not excite surprise. Four grains of Dover's powder (containing less than half a grain of opium) were given to a child four years and a half old. It soon became comatose, and died in seven hours. Death was referred to inflammation of the throat, and the jury returned the usual unmeaning verdict of "Died by the visitation of God," but there was no doubt from the evidence that death was caused by the opiate medicine. Dr. Kelso met with an instance where a child nine months old was killed in nine hours by four drops of laudanum, one-fifth part of a grain. It was much convulsed before death. A case is referred to in a late number of the Medical Gazette, in which two drops of laudanum, equal to the 10th part of a grain of opium, killed an infant. Instances of a similar kind are related by Dr. Christison. One is reported (Lancet, Feb. 1842) in which a child, two days old, was killed by a dose of a mixture containing one minim and a half of tincture of opium, equal to the 12th part of a grain. The child was seized with narcotism and coma, and died in fourteen hours. There are no appearances in the body under these circumstances to indicate death, and it is not very likely that the poison would be detected when taken in so small a quantity. Dr. Merriman met with an instance where a child, a month old, was thrown into excessive stupor by a single drop of tincture of opium contained in a dose of a mixture prescribed for it, the 20th part of a grain. He met with two instances where death was caused by a small dose of Godfrey's cordial, which contains opium. In 1837 an inquest was held in this city on an infant, aged four months, which was killed by half a teaspoonful of Godfrey's cordial. It was properly stated by the medical witnesses, that the proportion of opium is not more than half a grain to an ounce in that mixture; and one professed himself ready to swear, that half a teaspoonful could not have caused the death of the child. It is obvious, from what has been said above, that great caution should be exercised in expressing an opinion as to the quantity required to destroy the life of a young infant. We cannot measure the effects of opium on infants, by what we observe in adults: but still we find, that in spite of the accumulation of many facts, like those above related, there is often a disposition in medical witnesses to refer the death of a child in such cases to natural disease, because the quantity of opium taken happened to be insignificant. The nature of the symptoms, as well as the time of their occurrence after taking the medicine, and their aggravation after each dose, are the facts upon which a medical jurist must chiefly rely in forming an opinion. The post-mortem appearances in the body seldom furnish any information; and the poison is never likely to be discovered in the stomach, since it commonly exists only in fractional parts of a grain.

The quantity of this poison required to destroy life may present itself to a medical jurist as a question under another form; namely, whether a quantity, which, if taken at once would suffice to kill,—will prove equally fatal when administered at certain intervals in divided doses. This question is especially important in relation to the effects of opiate mixtures or powders on young children. There are, I believe, no facts on record, to enable us to return a precise answer to this question; but judging from the known operation of other poisons, and from one case of poisoning by opium, it appears to me certain when the intervals at which these divided doses are given, are so short that the patient has scarcely recovered from the effects of one, before another is administered, that the poison may destroy life when the whole quantity has been taken, although each dose individually might be harmless. If a sufficient time has elapsed between the doses for the patient entirely to recover from the effects, there may be some doubt whether death would follow; although it cannot be denied that opium may possess an accumulative power. (See case, ante, p. 236.) This form of poisoning may be called chronic poisoning by opium. The whole quantity taken at once, might kill in a few hours, while, in divided doses, it might not prove fatal for two or three days. It need hardly be observed, in reference to this question, that when the quantity of poison taken at one dose, is not sufficient to kill, it is less likely that death will follow from the medicine being given in divided doses.

PERIOD AT WHICH DEATH TAKES PLACE.—It has been remarked that most cases of poisoning by opium prove fatal in about from six to twelve hours. Those who recover from the stupor, and survive longer than this period, generally do well; but from some cases which have occurred, it would seem that there may be a partial recovery and afterwards a relapse. This was observed in the case of a man named Reitterhoffer, who destroyed himself by swallowing about ten grains of solid opium in 1838. The symptoms, however, generally progress steadily to a fatal termination, or the stupor suddenly disappears, vomiting ensues, and the individual recovers. Several instances are recorded of this poison having destroyed life in from seven to nine hours. Dr. Christison met with one which could not have lasted above five, and another is mentioned by him which lasted only three hours. while the shortest case reported, proved fatal in two hours. (Beck. Med. Jur. 873.) It is possible that the drug may even kill with greater rapidity than this; but as a medico-legal fact, we are at present entitled to state, that it has destroyed life in two hours and a half.

TREATMENT.—This consists in the removal of the poison by the stomach-pump as speedily as possible. Should the case be far advanced, coffee, tea, and other stimulants of the like nature, may be exhibited. Emetics are useful, where the stomach has power to act.

Cold affusion has also been adopted, and in infants the plunging of the body into a warm bath and suddenly removing it from the water into the cold air, has been found a most effectual means of rousing a young infant. Flagellation to the palms of the hands and soles of the feet or the back has been successfully employed. A common way of rousing a patient is to cause him to keep in continual motion, by making him walk between two assistants. Above all things, the tendency to fall into lethargy must be averted ; where this lethargy has existed galvanism is said to have been found serviceable, but whichever of these plans of treatment may be selected, no time should be lost. In a case where two ounces and a half of laudanum had been taken, and the patient refused to submit to the usual treatment, an emetic was injected per anum and with success. (Med. Gaz. viii. 112.) Artificial inflation of the lungs has also been found useful in the lethargic state. There is great doubt whether bleeding be beneficial. From cases reported by Mr. Bullock it would appear to be decidedly injurious. When there are signs of recovery, ammonia applied on rags to the nostrils, and frictions to the chest with the compound camphor liniment, will aid in restoring the patient. The means above stated variously applied, have been found to be eminently successful, more especially the removal of the poison by the stomach-pump. Out of many cases of poisoning by opium, brought to Guy's Hospital, but very few have proved fatal, even where the remedial treatment was applied late.

Poisoning by poppies.—The heads of the white poppy, grown in this country, contain meconate of morphia. They yield an inspissated extract called English opium, which is said by Mr. Hennell to contain five per cent. of morphia. The white poppy-heads, therefore, yield to water in the form of decoction a poisonous salt capable of acting deleteriously on young children. Many cases of poisoning have occurred from the injudicious use of syrup of poppies, which is nothing more than a sweetened decoction of the poppy-heads. This syrup is said to contain one grain of extract (opium) to one ounce (Thomson ;) but there is great reason to believe, that what is sold by many druggists as a soothing medicine for children, is a mixture of tincture or infusion of opium with simple syrup ; it is therefore a preparation of very variable strength. This will account for what appears often inexplicable, namely, that an infant will be destroyed by a very small dose. In January, 1841, a child six months old is said to have died from the effects of less than half a teaspoonful of syrup of poppies, bought at a retail druggist's. The narcotic symptoms were fully developed in three quarters of an hour. The syrup in this case probably consisted in great part of tincture of opium. Seven children lost their lives by this syrup in 1837—8. In one of these cases a teaspoonful and a half was given. Stupor came on in half an hour, and the child died the following day. The following are cases of poisoning by the decoction. A woman boiled two poppy-heads in a quarter of a pint of milk, and gave two small spoonfuls of this decoction to her child. In an hour, the child fell into a deep lethargic sleep,—the respiration became stertorous, and in ten hours the child died. On inspection, the brain and its membranes were found congested. In a second case, a maid-servant, in order to quiet a child, gave it two teaspoonfuls of a decoction made by boiling one poppy head in a small pot of water. The child was found dead in the morning. The brain and its membranes were much congested; and the ventricles contained bloody serum. The seeds of the poppy were found in the stomach.

It may be observed that the poisonous salt of morphia is generally considered to exist in the capsule of the poppy and not in the seeds; but Sobernheim mentions one or two cases of poisoning by the seeds of the plant (Tox. 500).

Godfrey's cordial.—This is chiefly a mixture of infusion of sassafras, treacle, and tincture of opium. The quantity of tincture of opium, according to Dr. Paris, is about one drachm to six ounces of the mixture. A case has been already related, in which half a teaspoonful probably caused the death of an infant. In 1837-8, twelve children were killed by this mixture alone. The explanation of this is, that the medicine is given in large doses by very ignorant persons.

Dalby's carminative.—This is a compound of several essential oils and aromatic tinctures in peppermint water, with carbonate of magnesia and tincture of opium. According to Dr. Paris, there are five drops of the tincture of opium to two ounces of this mixture; but in another formula it is stated that this tincture forms one eighteenth part of the liquid. (Med. Gaz. xxxi. 269.) Like most of these quack preparations, it probably varies in strength. An infant is reported to have been destroyed by forty drops of this preparation,—a quantity equivalent to little more than two drops of the tincture of opium. Accidents frequently occur from its use, partly owing to ignorance, and partly to gross carelessness in mothers and nurses.

The tincture of opium (LAUDANUM) of the London pharmacopœia contains about one grain of opium in nineteen drops; and from this datum we may infer the strength of those preparations of which it forms a part. When children are poisoned by opiate compounds, prescribed by druggists and others, the medical witness must be prepared for a very specious ex-post-facto defence; namely, that the particular tincture or preparation was not made according to the pharmacopœia, but according to the druggist's own formula. It is very well known that fractional parts of a grain of opium cannot be easily separated from any opiate preparation; and that by no chemical process can the exact quantity of opium in any mixture be determined, and therefore this appears to be a very convenient way of attempting to evade all kind of responsibility for the result. Thus if by mistake or carelessness one drachm of the tincture of opium be administered to a child and cause death with the usual symptoms of narcotism, and a medical witness proceeds to infer from the known strength of the ordinary tincture that at least three grains of opium were present in that dose, and were sufficient to destroy life, he may be met with the answer, that the tincture in question was a private preparation, and not made according to the pharmacopœial process. It need hardly be observed, that if such a defence as this were admitted, no person could ever be convicted of poisoning under the circumstances. Perhaps the better rule would be for a witness to say whether there was or was not sufficient of the particular opiate preparation present, to cause death, without speculating upon the precise fractional quantities of the drug to which this might correspond. The symptoms will indicate whether they were or were not due to the medicine; and I fully believe that no judge or coroner, when there was a strong medical opinion in favour of poisoning, would permit an accused party to shelter himself under such an evasion as this. It would be equivalent to giving him the power of escaping all responsibility for malpractice. The preparation used would be taken to be of the proper pharmacopœial strength, unless the contrary were clearly made to appear. This kind of defence was set up in a well-marked case of poisoning by paregoric, in which Dr. Babington, Mr. M'Cann, and myself, were lately consulted, (see post, Paregoric elixir,) although there could be no medical doubt that death was caused by the poison, and a verdict was returned accordingly.

MORPHIA AND ITS SALTS.—These bodies act as poisons, but with more intensity than opium. Morphia, from its insolubility, is said to be less energetic than its salts; but the acids of the stomach would probably suffice to render it soluble and poisonous. According to Orfila, one part of morphia is equal in power to four parts of crude opium. Dr. Christison thinks, that half a grain is fully equal to two or perhaps three grains of the best Turkey opium. The dose of morphia or its salts, is stated to be from one-eighth of a grain to two grains. Morphia itself is seldom used,—the few cases of poisoning that are reported, have occurred from over-doses of its salts.

The SYMPTOMS and POST-MORTEM APPEARANCES produced by these substances, so far as can be ascertained, are much the same as in cases of poisoning by opium. They consist in dimness of sight, weakness, loss of consciousness, coma, stertorous respiration, and more commonly than in poisoning by opium, there are convulsions. The pupils have been found both contracted and dilated, and in some cases there has been great irritation with itching of the skin. These symptoms come on in from five to twenty minutes. Vomiting and diarrhea have also been met with;—but in truth, well observed cases of this form of poisoning are rare.

With regard to the QUANTITY required to destroy life, this is a matter of some uncertainty, seeing that persons have recovered after taking considerable doses. The muriate of morphia has been given in doses of two grains every six hours without ill effects; but this was where it had been gradually raised from a quarter of a grain. I have been informed on good authority, that an adult who had taken this salt medicinally, was killed by a dose of three grains. Dr. Kelso suffered most formidable symptoms from taking only about half a grain of the muriate of morphia. (Lancet, Sept. 1839.) We meet with the most extraordinary statements relative to the acetate. Mr. Headland attended an opium-eater, who was in the habit of taking seventeen or eighteen grains daily. In some of these cases habit and certain states of nervous disease, will explain the comparative impunity with which very large doses of this poison may be taken. A case is reported by most toxicological writers of a young man who swallowed ten grains of the acetate, and shortly afterwards forty grains:—he suffered from the usual symptoms, but ultimately recovered, although he had taken in the whole, fifty grains of the acetate of morphia. In the Edinburgh Medical and Surgical Journal, (vol. xxxiii. p. 220,) a case is reported where a young man recovered in four days, after taking twenty grains of the acetate. It is difficult to say what is the smallest quantity that would destroy life. A child has been killed by ten grains of the sulphate given in the form of an enema, by mistake for sulphate of quinine. (Med. Gaz. iv. 220.) A physician was convicted in Paris some years since, of poisoning a person with the acetate. It is said that sixteen grains were given in this instance; and that the dose proved fatal in thirty-six hours. From an interesting case, which occurred in 1838, (Lancet, Nov.), there is reason to suppose that half a grain of the acetate of morphia, caused the death of a lady to whom it was administered as a medicine. She was at the time in an ill state of health. On the whole, there is considerable uncertainty as to the operation of morphia and its salts as poisons; but we are justified in regarding it as rather the exception to the rule, that a person should escape, who has taken more than two or three grains of either salt,—that a far less quantity than this will kill a child, and may kill an adult. Symptoms of poisoning have certainly been produced by one grain of the acetate.

The poisonous effects of these salts, as well as of all the other preparations of opium, may be produced through the medium of the skin, by introduction into wounds, or when injected as enemata into the rectum.

These poisons have been diligently sought for in the blood. M. Barruel states, that he detected morphia in the blood and urine of a person who had taken a poisonous dose of laudanum; but the result requires confirmation. Mr. Skae lately examined the urine of a person poisoned by opium, without detecting morphia; although the poison was discovered in the stomach.

Neither narcotine nor meconic acid appears to possess any poisonous properties. Narcotine is said to have acted as a poison, but in this case it was probably mixed with morphia. I have frequently found this mixture in specimens; and Dr. Christison states, that he has met with narcotine in morphia, a circumstance which may tend to explain the variable effects of this alkaloid in large doses. With respect to the other principles in opium, they require no notice in reference to legal medicine. Codeia is said to be poisonous; and one grain of this is considered to be equivalent to about half a grain of morphia. The common muriate of morphia of the shops is, according to Pereira, a compound muriate of morphia and codeia.

Chemical analysis. Opium. There are no means of detecting opium itself, either in the solid or liquid state, except by its smell and other physical properties, as also by exhibiting a portion of the suspected substance to animals, and observing the effect produced. The smell is peculiar, and as in the case of prussic acid, the odour of the poison is a good test of its presence. It may not always be perceptible, owing to the admixture with other matters in the stomach. The object of the chemist, therefore, is to seek for the salt to which opium owes its poisonous properties; namely, the meconate of morphia. It has been said, that the discovery of this salt, is not sufficient, (Barzellotti,) but that a medical jurist should also establish the presence of codeia, narceine, and the other numerous principles, which, according to late discoveries, exist as independent substances in opium. With these, however, the medical jurist, it appears to me, has no more concern, than with the detection of the gum, resin or extractive matter contained in the drug. There is no substance but opium or narcotic poisonous extracts resembling it which will yield on analysis meconate of morphia.

Morphia and its salts.—Morphia is known by the following properties. 1. It crystallizes in fine prisms, which are white and perfect, according to their degree of purity. 2. When heated on platina, the crystals melt, become dark coloured and burn like a resin with a yellow smoky flame, leaving a carbonaceous residue. If this experiment be performed in a small reduction tube, it will be found that ammonia is one of the products of decomposition. 3. It is scarcely soluble in cold water; and it requires one hundred parts of boiling water to dissolve it:—the hot solution has a faint alkaline reaction. It is not very soluble in ether, thus differing from narcotine. but it is dissolved by forty parts of cold, and rather less than this quantity of boiling alcohol. It is soluble in oils and in the caustic alkalies. 4. It is easily dissolved by all acids mineral and vegetable. 5. It has a bitter taste. In order to apply the chemical tests for morphia, it is better to dissolve it in a few drops of diluted acid, which may be either the acetic or muriatic.

Tests.—The three best tests for this alkaloid, are the following. 1. Nitric acid. This, when added to a moderately strong solution of a salt of morphia, produces slowly a deep orange red colour. If added to the crystals, deutoxide of nitrogen is evolved:—the morphia becomes entirely dissolved, and the solution acquires instantly the deep red colour above described,—becoming, however, lighter by standing. In order that the effect should follow, the solution of morphia must not be too much diluted, and the acid must be added in pretty large quantity. The colour is rendered much lighter by boiling;—therefore the test should never be added to a hot solution. 2. Permuriate of iron (sesquichloride). This, when neutralized, (by a small quantity of potash if necessary,) gives an inky blue colour in a solution of morphia. If the quantity of morphia be small the colour is greenish:—the blue colour is entirely destroyed by acids,—it is also destroyed by heat, but returns on cooling: thus this test should never be employed with a very acid or a hot solution of a salt of morphia. 3. Iodic acid. Morphia in the solid state or in solution decomposes this acid, taking part of its oxygen and setting free, iodine. In order to make this evident, the iodic acid should be first mixed with starch; and a part of this mixture only, added to the suspected solution,—part being reserved to allow of a comparison. It is said, that this test will detect the 1000th part of morphia:—if the quantity be very small, there is only a reddish or purple tinge, slowly produced, sometimes not for many hours:—if large, the dark blue iodide of farina is formed in a few seconds. This colour being destroyed by heat, the test must not be added to a hot solution. I have found also, that the presence of a large quantity of acid, prevents or interferes with the result. It succeeds equally well with morphia or its salts when unmixed with organic matter.

Objections.—1. Nitric acid: this test gives an orange yellow colour with gallic acid and many kinds of organic matter, but this colour is not likely to be confounded with the deep red tint of morphia:—besides it is presumed that there is no organic matter present. It might be mentioned that according to some, pure morphia is not thus affected by nitric acid. I have tried many specimens, some of a pure kind; but have never failed to obtain this result. Besides the morphia, used in pharmacy and as a poison, is not of such refined purity, but that it is always affected by nitric acid. A more important objection is that other alkaloids are similarly coloured by it:—thus common strychnia is turned of a scarlet colour; but does not readily dissolve in the acid,—small red lumps remaining in it for some time. Again, brucia is turned of a red colour, but is dissolved. In each of these cases, the red colour in the course of half an hour changes to a greenish brown, while that of morphia becomes of a light yellow. Narcotine is turned at once of a bright yellow colour, and therefore cannot be mistaken for morphia. Delphinia is said to give a similar colour, but I have found that this alkaloid forms with nitric acid, an iron-rust red solution, while the undissolved portions are of a dingy yellow colour. Veratria gives a light red tint. If the objections to this test are not thus removed, it may be observed, that none of the above alkaloids decompose iodic acid and set free iodine. 2. Permuriate of iron: this gives a blue tint with all solutions containing tannin or gallic acid, but this test could not with any propriety be used in an organic mixture;—or at least in such a case, no inference could be drawn from the production of a blue colour. It should be observed, that the blue given by the test in a solution of morphia is entirely destroyed by nitric acid, and replaced by the orange red, so that the nitric acid will act through the iron test, but not vice versâ. In this way two tests may be applied to one quantity of liquid. 3. Iodic acid. This acid, I have found to be liable to spontaneous decomposition, when long kept; and thus it should always be mixed with starch before adding it to the suspected liquid. This will show whether any free iodine be present or not. For the same reason, a portion of the iodic acid and starch should always be reserved for comparison. Iodic acid is similarly decomposed by sulphocyanate of potash, sulphuretted hydrogen, sulphurous, gallic acid and other bodies; but as we are now supposed to be examining a pure alkaline solid dissolved for the occasion, these objections are of no moment. Sulphocyanate of potash gives a reddish colour with nitric acid, but it forms a deep cherry red compound with the iron test, thus entirely differing from morphia. An important fact is, that no alkaloid yet discovered excepting morphia, possesses the property of decomposing iodic acid. These tests taken together, therefore, establish the presence of morphia. The objections to which one is exposed, if we except gallic acid, are removed by the application of the others; but gallic acid is easily known from morphia by its ready solubility in boiling water, and the acid reaction of its solution. If the salt of morphia be presented for examination in a state of solution, it should be evaporated to crystallization, and then redissolved in a small quantity of water.

Meconic acid.—This is a solid crystalline acid, seen commonly in scaly crystals of a reddish colour. It is combined with morphia in opium; and it renders that alkaloid soluble in water and other menstrua. It is soluble in four parts of water, and the solution reddens litmus. Many tests have been proposed for this acid; but there is only one upon which any reliance can be placed, namely, the permuriate of iron. This test gives, even in a very diluted solution of meconic acid, a deep cherry-red colour;—and it is owing to the presence of this acid that the salt of iron causes a deep red colour in tincture and infusion of opium, as well as in all liquids containing traces of meconate of morphia, the effect of the iron test with morphia being counteracted by the presence of meconic acid. The red colour of the meconate of iron is not easily destroyed by diluted mineral acids, by bichloride of mercury, nor by chloride of gold. It has been objected to the application of this test, that sulphocyanate of potash produces a similar colour with the salt of iron. This is certainly the case, but the red colour produced by the sulphocyanate is immediately destroyed by a few drops of chloride of gold or bichloride of mercury. The concentrated alkaline acetates, give a similar colour, and this is not removed by the metallic chlorides just mentioned, in which respect these salts resemble a solution of meconic acid;—but as they are neutral, and on boiling with an acid, acetic acid would be immediately evolved, no difficulty can arise on this ground. Besides, the red colour of acetate of iron is destroyed by a few drops of dilute sulphuric acid—that of the meconate is only removed by a very large quantity.

In organic mixtures.—Opium itself may be regarded as an organic solid, containing the poisonous salt which we wish to extract. It is not often that in fatal cases of poisoning by opium or its tincture, even when these are taken in large quantity, and death is speedy, that we can succeed in detecting meconate of morphia in the stomach. It is probably removed by vomiting, digestion, or absorption:—certainly not always by decomposition; for I have discovered its presence in organic liquids, kept for twelve and fourteen months, and allowed to decompose spontaneously under the free access of air. In the case of a young woman, who died five hours after taking two ounces of laudanum, Dr. Christison did not succeed in detecting morphia by any of the tests. Other cases of a similar kind are mentioned by him. In two instances of poisoning, I have been unable to detect any meconate of morphia,—in one, the man died twenty-four hours after taking nearly two ounces of the tincture: in both of these the stomach-pump had been applied. The following case occurred in June 1836. A woman swallowed an ounce and a half of laudanum in beer. In half an hour she was in a state of profound coma—she died in nine hours. None of the poison could be detected in the stomach, there was not even the smell of opium. On the other hand, Mr. Skae detected traces in one instance, where only two drachms of the tincture had been taken. (See anté, p. 237.)

By the following process, similar to that originally proposed by Lassaigne, I have found it easy to detect small quantities of the meconate of morphia in artificially made organic mixtures.

1. If the matter to be examined is a solid, it must be cut in slices, and a cold infusion made, the water being slightly acidulated with muriatic or acetic acid. After two or three days, it may be filtered and the dregs pressed in a cloth: should the matter be semiliquid (the contents of the stomach) it may be evaporated to an extract, and an aqueous infusion made of it in the same way.

2. This infusion, if in large quantity, should be concentrated by evaporation. As trial tests, nitric acid and permuriate of iron may be employed. The former will give, with a small quantity of the infusion, if morphia be present, a bright red colour, and the latter will also give a deep cherry-red colour, if meconic acid be present. The permuriate of iron is perhaps in this respect a more satisfactory test for the presence of opium in mixtures, than nitric acid, because the latter gives the same colour with an infusion of nux vomica, with which the iron test produces a green instead of a red tint. Supposing that by these tests, applied to a portion of the liquid, it is rendered probable that opium is present,—we should acidulate the infusion with acetic acid, and add a solution of acetate of lead until there is no further precipitation. The mixture may then be boiled and filtered:—the residue on the filter is impure meconate of lead.

3. A current of sulphuretted hydrogen gas should now be passed into the filtered liquid, and this will have the effect of throwing down not only any superfluous salt of lead, but also a large portion of organic matter. The liquid should be again filtered, evaporated to crystallization, and the crystalline residue redissolved in alcohol, whereby the impure acetate of morphia may be brought to a state fitted for testing.

4. In order to detect meconic acid, we may decompose the impure meconate of lead by a current of sulphuretted hydrogen gas, or by boiling it with diluted sulphuric acid. In the latter way the decomposition is effected in a few minutes, and the liquid which passes through the filter, is a mixture of meconic and sulphuric acids. If much coloured, it may still be detected by applying the iron test:—the small quantity of free sulphuric acid present, does not prevent the action of this test, while it would destroy any acetate, and lead

to the evolution of an odour of acetic acid. Further, the red colour produced should not be removed by the addition of a few drops of a solution of corrosive sublimate or chloride of gold. I have met with one source of error in pursuing this process which may be here adverted to. If acetic acid be used largely for acidulating the suspected poisonous infusion to promote the solubility of the meconate of morphia, and this acid be neutralized by an alkali before adding the acetate of lead, the filtered liquid separated from the meconate of lead would contain an alkaline acetate, and this would strike a red colour with permuriate of iron, resembling the meconate, instead of a blue colour indicative of morphia. The addition of dilute sulphuric acid and a gentle heat would soon show, by discharging the colour, that it was not due to the presence of meconic acid. In these delicate analyses, where the quantity of morphia has been small, I have found the permuriate of iron and iodic acid much less satisfactory as tests for morphia than nitric acid. They have repeatedly failed, when nitric acid has satisfactorily indicated morphia, and the permuriate of iron, meconic acid.

If the acetate of lead gives no precipitate, even on boiling, with the concentrated aqueous infusion, the quantity of meconate of morphia present is too small for separation. On the other hand when a precipitate is given, we must not always infer that meconate of morphia is present, since numerous bodies will precipitate that reagent. The oxide of lead may itself be thrown down by organic matter only. The meconate of lead is known from these precipitates by being insoluble in acetic acid.

In this way we prove the presence of morphia and meconic acid; but it has been objected, that the tests for both (iodic acid and permuriate of iron) will give the same results with saliva, from the sulphocyanate of potash contained in it, as well as with a decoction of mustard for the same reason; for both of these liquids set free iodine from iodic acid, and give a red colour with permuriate of iron. It is also said that albumen and serum will decompose iodic acid and produce the blue iodide of farina. In respect to saliva:—half an ounce of this secretion will give sometimes, but not always, a deep cherry-red colour with permuriate of iron, immediately removable by bichloride of mercury or chloride of gold. The same happens with infusion or decoction of mustard seed, but it does not seem to me that such substances could exist in the liquids derived from the stomach by the above-mentioned process; and the objection could never hold with respect to any organic mixture (not containing mustard,) which had not been swallowed. I have not found that albumen and serum decomposed iodic acid;—but even if this were the case, they would be destroyed and removed by the above process of extraction. The alkaline acetates could present no objection, since they would be entirely decomposed by sulphuric acid.

In respect to this method of detecting the meconate of morphia in suspected liquids, it is proper to observe, that nitric acid will indicate the presence of morphia, and permuriate of iron the presence of meconic acid in infusions containing so small a quantity of opium as scarcely to be rendered more than faintly turbid by the addition of the acetate of lead. Dr. Ure has found that one hundred grains of opium will yield about twenty-seven grains of washed but impure meconate of lead. (Med. Gaz. vi. 73.) If we adopt this as a fair estimate, one grain of opium would yield only about a quarter of a grain of the meconate of lead. The meconic acid might easily be determined to be present by the iron test, in a liquid containing only one grain of opium; but it would require more than usual chemical skill to obtain so small a quantity of precipitate in such a state as to allow of the separation of the meconic acid. So nitric acid might indicate morphia, when the quantity of opium in a liquid amounted to one grain or less, in which case the proportion of morphia might vary from one-fourteenth to one-twentieth part of a grain. This would not admit of easy separation; hence unless we obtain a tolerably free precipitate of meconate of lead, insoluble in acetic acid, it will not be in our power to obtain the morphia and meconic acid separately.

There are no satisfactory means of determining the *quantity of opium* present in a suspected liquid. Dr. Ure has recommended that we should rely upon the depth of colour produced, on the addition of permuriate of iron to the liquid,—considering that the intensity of the red colour will indicate the presence of a large quantity of meconic acid, and consequently of meconate of morphia.

In comparing different specimens of opium, he has found this a fair method of determining the relative proportions of morphia. For this purpose, two grains of each specimen may be dissolved in alcohol, or equal measures of two different tinctures may be at once taken and diluted with sufficient water to make the respective liquids colourless. Each liquid should be put into a graduated glass cylinder; and an equal quantity of permuriate of iron added to the two. The red tints produced may then be compared; and if one be deeper than the other, the quantity of water required to be added to render the tints of equal depth, will serve as a measure of the relative strength of the two specimens. This method is not very accurate; but it is perhaps the best which has been yet devised.

It might be supposed that greater accuracy would be obtained by first removing the colour of the organic liquid in boiling it with animal charcoal; but I have found what has been repeatedly observed by others, that this is apt to diminish the effect of the test. Thus one drachm of a coloured infusion of opium, which gave, when diluted with water, an intense red colour with permuriate of iron, was only faintly reddened, after the infusion had been rendered clear by boiling with washed animal charcoal. The colour produced by nitric acid from the presence of morphia, was also less intense after, than before digestion with animal charcoal. In some cases, this purification by charcoal cannot be dispensed with, and the chemist must then submit to an unavoidable loss.

With respect to the muriate and acetate of morphia, these could only be obtained from an organic liquid by evaporating it to an extract, and digesting this extract in alcohol. In this case, the tests for morphia only could be applied:—the respective acids might, however, be detected by their appropriate tests.

There are two common preparations of opium, in which the morphia appears to be combined with acetic acid, and very little meconic acid is present. These are the BLACK DROP and BATTLEY'S SEDATIVE SOLUTION. The process might entirely fail to detect meconic acid in these, hence we should treat the solutions as organic mixtures, containing the acetate of morphia. It may be mentioned that the black drop is considered to have three times the strength of the tincture of opium, while the sedative solution is weaker than the black drop, but stronger than the tincture.

The sedative solution appears to be an energetic preparation. Mr. Streeter stated at the Westminster Med. Soc. Dec. 1838, that he had known one drachm and a half of it prove fatal to a lunatic; and twenty minims of the solution destroyed the life of an old woman.

PAREGORIC ELIXIR. (COMPOUND TINCTURE OF CAMPHOR.)—This is a medicinal preparation of alcohol, opium, benzoic acid, oil of aniseed, and camphor. Opium is the active ingredient, and of this, the tincture contains about one grain in every half ounce. I have only met with one case of poisoning by paregoric:—this was referred to me for examination by Mr. M'Cann, in March 1843. A child between five and six years old, had had some cough medicine prescribed for it, at a chemist's. The medicine consisted, as nearly as I could ascertain from a portion left in the bottle, of paregoric, having about from one fourth to one-half the strength of the pharmacopœial tincture. The child took about two-thirds of this mixture, given in divided doses, at somewhat irregular intervals, and died in about thirty-six hours. The quantity of opium in the portion of the mixture taken, was, judging by comparison with the usual strength of the tincture, from three-fourths of a grain to one grain and a quarter. The child became drowsy after each dose, and slept on one occasion for seven hours together. It was occasionally roused, and appeared sensible; but again relapsed into drowsiness on taking the medicine. A few hours before its death, it was found comatose with stertorous breathing and contracted pupils.

On inspection, the whole of the organs were healthy, with the exception of the parietes of the ventricles of the heart, which were somewhat thickened;—there was no turgescence in the brain, nor effusion in the ventricles. The liquid contents of the stomach yielded no trace of opium or an opiate.

There was no doubt that the death of this child had been caused by an opiate. This was proved, 1, by the nature of the medicine taken; 2, the nature of the symptoms, which were aggravated after each dose; 3, the confirmed coma and stertor; and, lastly, the absence of every other cause to account for the rapid death under the circumstances.

It was a question here, how far a small quantity of opium in divided doses was likely to prove fatal to a child of this age? The answer given was to the effect, that although each dose might be individually harmless, the frequent repetition of the medicine, while the child had scarcely recovered from the effects of the former dose, might operate fatally.

CHEMICAL ANALYSIS.—It is impossible to separate meconic acid and morphia from a small quantity of this mixture; but the presence of those bodies may be determined by distilling at least half an ounce,—thus getting rid of the alcohol, oil of aniseed, and other volatile ingredients. The extract in the retort, which contains the opium, may be digested in water, filtered, and treated if necessary with animal charcoal; the morphia may then be discovered by the action of nitric acid, and the meconic acid by the action of permuriate of iron. A mixture of alcohol, benzoic acid, oil of aniseed and camphor, is not affected by these tests, unless opium, as meconate of morphia, be present. If the paregoric be pure, and made according to the pharmacopœial process:—the contents of the receiver should on agitation form a clear liquid:—if weak, or mixed with much water, the liquid in the receiver I have found to remain milky. This tincture is, however, very well known by its odour, flavour, and its giving an abundant milky precipitate with water (oil of aniseed and camphor). As an ounce of it contains only the tenth part of a grain of morphia, it is easy to understand that it would be a matter of extreme difficulty to separate the alkaloid.

DOVER'S POWDER. (PULV. IPECAC. COMP.) This is a preparation of opium, the fatal effects of which on children have already been adverted to. The proportion of opium is one grain in every ten grains of the powder. A child has been killed by four grains—therefore by a quantity containing about two-fifths of a grain of opium.

CHAPTER XXVI.

POISONING BY HYDROCYANIC ACID. OIL OF BITTER ALMONDS.

HYDROCYANIC or prussic acid is one of the most formidable poisons with which we are acquainted, owing to its rapid and unerring effects when taken even in comparatively small doses. The pure or anhydrous acid requires no notice here; since it is not likely to be met with out of a chemical laboratory. The common acid is a mixture of this pure acid with water, and sometimes with alcohol. As it is sold in shops, it varies considerably in strength. I have found different specimens to contain from 1·3 to 6·5 per cent. of the strong acid; but we now commonly meet with three varieties. 1. The prussic acid of the London Pharmacopœia, containing about two per cent. (Phillips.) 2. Vauquelin's acid, containing about three per cent. or rather more; and 3. Scheele's acid, containing five per cent. The variable proportions of strong acid present, will explain the different effects produced by equal quantities of different specimens. On the continent, the acid is met with of a strength sometimes rising as high as from ten to twenty-five per cent.

Poisoning by prussic acid is commonly the result of suicide or accident:—it cannot be easily administered with a murderous intention, except where it may be substituted for medicine. In 1837-8 there were twenty-seven cases of poisoning by this liquid, nearly all of which were the result of suicide.

SYMPTOMS.—The time at which these commence in the human sub ject has not been accurately ascertained, because the case is seldom seen until the patient is dead. When a large dose has been taken, as from half an ounce to an ounce of the diluted acid,—the symptoms may commence in the act of swallowing, or within a few seconds. In no case, probably, is their appearance delayed beyond one or tw minutes. When the patient has been seen at this period, he has been perfectly insensible: there was convulsive respiration at long intervals and the patient appeared dead in the intermediate time.

The following case, communicated to me by my friend Mr. French, oc curred in June 1837:—it presents a fair example of the effects of this poiso in a fatal dose. A surgeon in large practice swallowed seven drachms of th common prussic acid. He survived about four or five minutes, but was quit insensible when discovered, i. e. about two minutes after he had taken th dose. He was found lying on the floor, senseless,—there were no convulsior of the limbs or trunk, but a faint flickering motion was observed about th muscles of the lips. The process of respiration seemed to cease for som seconds:—it was then performed in fits, and the act of expiration was r markably deep, and lasted for a long time. The deceased swallowed the poison while ascending the stairs; his body was found on the landing. The bottle had rolled some distance from him, and the stopper was lying in another direction.

Simon mentions a case in which an ounce was taken, and the symptoms were precisely similar. There was besides coldness of the hands and feet; but no pulse was to be felt. In all such cases, the breath exhales a strong odour of the acid. Convulsions of the limbs and trunk are sometimes met with among the symptoms. The finger nails have been found of a livid colour, and the hands firmly clenched.

When a small dose, i. e. about thirty drops of the common acid, had been taken, the symptoms observed, were weight and pain in the head, with nausea and quick pulse. In one or two cases, these symptoms have been followed by salivation. Vomiting is rare; but in animals it is not unusual to observe vomiting, and this is followed by tetanic spasms, opisthotonos and death.

If we contrast the effects of this poison with those of opium, we shall find the following general differences. In opium the coma comes on gradually; and is seldom seen until after the lapse of a quarter of an hour:—in poisoning by prussic acid, coma is instantaneously induced:—even in weak doses, insufficient to prove fatal, this symptom is seldom delayed beyond two minutes. Convulsions are met with in both forms of poisoning, but perhaps more commonly in poisoning by prussic acid:—with respect to the occurrence of this symptom, it is a fair question, whether medical jurists have not too readily adopted views from experiments made on animals, and not from observations on man: since in very few instances, where the dose of poison has been large, has the patient been seen alive. In poisoning by prussic acid, the case, if fatal, generally terminates in an hour: in poisoning by opium, the average period of death is in from six to twelve hours.

This poison will act through a wounded portion of skin. Sobernheim mentions the case of an apothecary at Vienna, who died in an hour from the entrance of the acid into a wound in the hand, produced by the breaking of a glass vessel, in which it was contained. It is also said to act through the unbroken skin; but this certainly does not appear to be the case with the common diluted acid.

A question has arisen, as to whether this poison possesses an accumulative power, i. e. whether, after having been taken for some time, in a small dose without apparent mischief, it may not suddenly give rise to all the effects of poisoning, either by a repetition of the same dose, or by a very slight increase in quantity. Dr. Lonsdale, who has examined the effects of this acid, does not admit that it possesses this property. One case is reported, however, which renders this opinion probable; and another has been communicated to me, which bears out this view of its operation. The question is yet unsettled; but as Dr. Geoghegan has observed, it is a matter of considerable importance in respect to the medicinal use of the acid. Serious effects have repeatedly resulted from slight alterations made in the dose; but the proper test would be to observe, whether such effects follow when the same dose of the poison is long continued.

POST-MORTEM APPEARANCES.—The body commonly exhales a strong odour of prussic acid when seen soon after death; but if it has remained exposed for some time before it is seen, and more especially if exposed in the open air or in a shower of rain, the odour may not be perceptible. In cases of suicide or accident, the vessel out of which the poison has been taken will commonly be found, but there is nothing to preclude the possibility of a person throwing it from him in the last act of life. Putrefaction is said to be accelerated in these cases; but from what I have been enabled to collect, there seems to be no ground for this opinion, any more than in the case of poisoning by opium. Orfila has shown that in most instances of sudden death from whatever cause, putrefaction is, cæteris paribus, accelerated; and the fact that in one or two instances, the bodies have speedily putrefied, has improperly led to this condition being set down as one of the characters of poisoning by this acid.

The morbid appearances are very slight and imperfect:—the eyes have been observed to be prominent and glistening, but this condition exists in other kinds of death. The venous system is gorged with blood:—the stomach and alimentary canal are in thei natural state; but in some rare instances they have been found inflamed. On opening the stomach, the odour of prussic acid is commonly very perceptible for several days after death:—if death ha been rapid and the inspection recent, all the cavities as well as th blood have the odour: but the organs of persons who have died from natural causes, have been occasionally found to present a similar odour I once perceived it in the brain of a subject who had died from ord nary disease, and whose body was examined soon after death. Agai it is not always present in poisoning by prussic acid. The odour was not perceptible in the body of a youth who had been killed by three and a half drachms of the acid, and whose body was inspected thirty hours after death. Besides these appearances, the brain has been found congested, the blood liquid, and in two cases examined b Mertzdorff, the gall-bladder had a blue tint. (Sobernheim, 465.) Th larynx, trachea, and œsophagus are said to have been found reddened but it is not impossible, that this redness may have depended on a cidental causes, since prussic acid appears to have no action as an ir tant or corrosive,—and death takes place with such rapidity, as scarc ly to allow of the production of morbid changes in the living bod This will account for the paucity of the appearances. In a case r ported by Dr. Geoghegan, where a man swallowed an ounce of pru sic acid, and was found dead, the only morbid appearance of note d covered, was a patch of dark red extravasation, under the muco membrane of the stomach near the pylorus. The stomach in th case, exhaled the odour of hydrocyanic acid, although it had be exposed for three days, but the poison was then easily detected the usual means in its contents. From this account, it will be p eived, that there is nothing to be derived from an inspection of the ody, at all characteristic of the mode of death; and probably no susicion would be excited except for the presence of the well-known dour. Pathologists are here as much at a loss, as in fatal cases of etanus and hydrophobia.

QUANTITY REQUIRED TO DESTROY LIFE.—This is a very important question: and it is made somewhat perplexing by the fact, that beyond a certain dose, the weak and the strong acid appear to act with equal rapidity. (Christison, 658.) It has been already stated, (antè, p. 70,) that six drops have been found to destroy the life of an animal —as rapidly as one ounce of the same acid:—the animals being alike in strength and vigour. If any inference could be drawn from these experiments applicable to the human subject, it is clear that the view often adopted, of the rapidity of death being in proportion to the largeness of the dose, is erroneous. This view may be true to a limited extent; but it appears to me that a most improper application of the doctrine has been made from a few experiments. Admitting that two drachms of Scheele's acid, will certainly kill an adult within a given period, it by no means follows that four times that quantity would kill a similarly constituted person, within one-fourth of that period. Yet this has been made the basis of evidence by medical witnesses, as if it were a positively established fact. I have sought through works on toxicology and our periodical journals, in vain for facts by which such a view could be supported. It is directly opposed to what we observe in the action of other poisons; for it is in general impossible to say, within what time a case will prove fatal, from the actual quantity of poison taken. In a case related by Dr. Geoghegan, a quantity of the acid, equal to almost twenty-eight drops of the English pharmacopœial strength, (at two per cent.) was taken by a gentleman without any effect, the dose having been gradually raised to this point; but no bad consequences whatever had resulted from the acid previously taken:— he now raised the dose to thirty-seven drops, and in two minutes he was seized with the usual symptoms, and nearly lost his life. (Dublin Med. Journ. viii. 308.) The quantity of strong prussic acid, swallowed in this dose, was less than three quarters of a grain, which is the largest quantity I have known to be taken without destroying life. This case shows that there is a very narrow line, between the quantity of the poison which may be taken with impunity, and that required to produce death. In determining the quantity necessary to prove fatal, we must, it appears to me, avoid the results obtained by experiments on animals, and look to those facts only which have been ascertained from observation on the human subject. In general, the quantity taken is extremely large; but the smallest dose which is reported to have caused death, was in the case of seven patients in one of the hospitals of Paris. By mistake a dose equal to 0.7 grain of real acid, was given to each patient, and they all died in from thirty minutes to three quarters of an hour. The symptoms began in ten minutes, and there were in all, at first convulsions and then coma.

This quantity would be equivalent to about thirty-five drops of the pharmacopœial acid, and to fourteen drops of Scheele's. It has just been stated, that Dr. Geoghegan's patient, who took a similar dose, recovered. A case is related by Sobernheim, of a physician at Rennes, who swallowed a teaspoonful of Scheele's acid; and some hours afterwards, another teaspoonful of Vauquelin's acid. The two doses were equal to about one drachm and a half of Scheele's acid. In a few minutes, he fell senseless, and was seized with convulsions and tetanic spasms. He recovered his senses, and was able to prescribe for himself in about three hours; but he did not wholly recover for thirteen days. Admitting that the strength of the acid was as represented, this is the largest dose which has been taken without causing death; but knowing what uncertainty there is on this point, and that in the Parisian cases, seven persons were killed by doses equivalent to only one-third of this quantity,—I am inclined to think, that the acid, which had been prepared by himself, could not have been so strong as it was suspected to be. In answer to a question of this kind, it appears to me, we should be justified in saying, that a dose of Scheele's acid above twenty drops, or an equivalent portion of any other acid, would commonly suffice to destroy life.

Period at which death takes place.—Some remarks have already been made on this subject, and it has been particularly stated that beyond a certain point, we are not entitled to infer, that the rapidity of death bears any proportion to the quantity of poison taken. Experiments on animals might be adduced to prove either the negative or affirmative of this proposition, a fact which clearly shows, that they cannot be admitted in this particular, as a basis for medical evidence. In the Parisian cases, where the same dose was given, death took place at very different periods,—some died in a few minutes, and others only after three quarters of an hour. In one instance in which seven drachms were taken, death took place within five minutes:—in another, in which an ounce was taken, the individual survived about ten minutes. (Sobernheim.) When the dose is two drachms and upwards, we may take the average period for death at from two to five minutes. It is only where the dose is just a fatal proportion, that we find the individual to survive from half an hour to an hour. In this respect, death by prussic acid is like death by lightning:—the person either dies speedily or recovers altogether.

But although death does not commonly ensue until after the lapse of a few minutes, insensibility, and consequently a want of power to perform acts of volition and locomotion, may come on in a few seconds. The time at which this loss of power is supposed to take place, has already become an important medico-legal question, and on the answer to it, the hypothesis of suicide or murder in a particular case, must rest. Dr. Lonsdale says on this point, that a drachm of Scheele's acid would affect an ordinary adult within the minute; and if the dose were three or four drachms, it would exert its influence within ten or fifteen seconds. When the acid is stronger and the quantity larger, we are pretty certain of its *immediate* action, and the consequent annihilation of the sensorial functions. (Ed. Med and Surg. Journ. li. 50.) This opinion is founded entirely on experiments on animals. Dr. Christison ascertained that a quantity of poison, equivalent to two scruples of medicinal acid, did not begin to act on a rabbit for twenty seconds, and certainly for so small an animal, two scruples are as large a dose as *five drachms* given to a grown-up girl. These statements appear to me to show that experiments on animals cannot enable us to solve this question : we should rather trust to the few observations made on the human subject, as well as to analogy from other sources,—as, for example, to the fact of survivorship after the receipt of what are commonly regarded as instantaneously mortal wounds. A case is related by Sobernheim, quoted from Dr. Gierl, where an apothecary's assistant went to a cellar in order to procure a drug. After a few minutes, he was heard to cry out, " hartshorn." Some persons hastened to the cellar, and found him on the lower steps, just uttering the words " prussic acid,"—he then fell dead, about five minutes after going to the cellar : it appears that he had tried to remove the cover from the bottle of ammonia, but had not succeeded : the quantity of poison which he swallowed is not stated.

A case was communicated to me, some time since, by one of my pupils, where a man was found dead on the seat of a water-closet : he had died from prussic acid, and the bottle which had contained the poison was found in his pocket corked. These facts appear to show, that while, as a general rule, insensibility must supervene from a large dose of this poison in a few seconds, the individual occasionally retains a power of performing certain acts, indicative of volition and locomotion. This question was brought to a close issue in a case tried at the Leicester Spring assizes in 1829.

A young man, named Freeman, was charged with the murder of a female, named Buswell, by administering to her prussic acid. A full report of this case will be found in the Medical Gazette (Vol. viii. p. 759). The deceased was a maid-servant in the family of a chemist, to whom the prisoner acted as assistant. The deceased was one morning found dead in her bed : her death was evidently caused by prussic acid, and it was presumed that she had taken four-and-a-half drachms of the poison ; the bottle out of which she must have drunk it, or had it administered to her, holding an ounce, and still containing, when found, three-and-a-half drachms.

Owing to the position, and other circumstances connected with the body when discovered, it was inferred that she could not have taken the poison herself. Her body was lying at length on the bed, the head being a little on one side. The bed-clothes were pulled up straight and smooth, and they came up to the breast of the deceased ;—her arms were under the clothes, and crossed over the chest. On turning the clothes aside, the phial which contained the poison was found lying on her right side. It was corked, and there was a piece of white paper round it,—the leather and string which appeared to have gone round the neck of the bottle, were found in the chamber vessel. The medical question was,—Could this quantity of poison have been taken, and the deceased have afterwards performed these acts herself ? Five medical witnesses were examined, and the opinions of four of these were strongly against the possibility of the acts having been performed by the deceased. One of these ascertained, that a dog to which the same quantity of acid was given, as was taken by the deceased, died in about three seconds. The medical opinion was founded on experiments of this kind; for there were no cases from the human subject, by which it could be supported. All of the acts to which the opinion referred, might be performed in from five to eight seconds; and there is nothing to warrant us in supposing, that under the abovenamed dose all power would necessarily have ceased before that period had elapsed. Dr. Christison's experiment on the rabbit would lead to the inference that even five drachms would not begin to act upon a grown-up girl for twenty seconds; (668), and the results obtained by the witnesses from their experiments on dogs, were by no means uniform, even allowing that they were justified in applying them to so important a question as this. The medical opinion was completely set aside by circumstances, and the prisoner was acquitted.

A similar case has since occurred in Germany, and is quoted by Sobernheim. A young man swallowed four ounces of an acid (of four per cent.) equivalent to eight ounces of the pharmacopœial strength. He was found dead in bed,—the clothes drawn up to his breast, the right arm stretched out straight beneath the clothes, the left bent at the elbow-joint, and on each side of the bed lay an empty two-ounce phial. There was no doubt of this having been an act of suicide. In deciding a question of this kind, it ought to be remembered, that very few cases have occurred where the poison was swallowed in the presence of a person competent to watch and form an opinion on so important a point; and no experiments on animals can justify us in saying, whether insensibility, from a particular dose taken by a human being, began in five, eight, fifteen, or twenty seconds. In the German case, more than three times as much acid was taken as in that of Buswell, but even here there was time for the performance of very similar acts. It is besides much more difficult to understand, how the poison should have been taken out of two phials, than out of one.

Can a man, after having taken prussic acid, live sufficiently long to attempt or perpetrate suicide in any other way? The following case occurred in London in April 1839. A solicitor's clerk was found hanging quite dead at his chambers. He had evidently taken prussic acid; for a cup was lying near him which had contained that poison. The medical witness here very properly inferred, that the man did not swallow the poison until after he had adjusted the rope round his neck. It could hardly be admitted that a man should have power to hang himself, after having taken a large dose of this poison, but a person might be found drowned with prussic acid in his stomach, and without this fact being incompatible with suicide. It is however a matter of doubt, determinable only by special circumstances, whether a man could destroy himself by fire-arms after having swallowed the poison.

This question often presents itself in another form, namely, whether the act of poisoning was the result of accident or suicide,—a most important question, where the life of the deceased happens to be insured. In general the circumstances are such as at once to explain the nature of the act; but a medical witness must remember that there is no case in which suicide may be so secretly perpetrated by poison, as by means of prussic acid. There are besides many ways in which the means of death might be concealed; and as it is so little the custom to cause an inspection to be made of the bodies of those who have died suddenly, unless a suspicion already exists of death having been caused by poison, such cases might easily escape detection. In the event of litigation ensuing, in respect to a policy of insurance it may be too late to discover any traces of poison in the body. It is proper therefore to remark, that the effects of prussic acid may be easily confounded with all diseases which are liable to destroy life suddenly, such as epilepsy, apoplexy, and diseases of the heart.

The case of Mrs. Macleau, who was found dead in her house at Cape Coast Castle, in October 1838, is interesting to the medical jurist, in relation to the question of suicide or accident. Her attendant, in going to the room of the deceased, found some difficulty in opening the door, in consequence, as it appeared, of the body of the deceased having fallen against it. The deceased was lying on the floor, quite senseless, with an empty bottle in her hand, uncorked, and labelled "hydrocyanic acid, medium dose five minims." There was a feeble pulsation of the heart, which soon ceased. It appeared that the deceased was in the habit of taking prussic acid as a medicine; and the medical witness supposed, that she might have taken an overdose, and have thus been killed accidentally; he was so fully convinced that the medicine was the cause of death, that he did not open the body. By this omission, the case was left in mystery; for had the body been inspected, and the larger portion of the contents of the bottle been found in the stomach, there would have been no doubt of its having been an act of suicide; since a well-informed person like the deceased, was not likely to have swallowed by accident a large dose of a poison, with the deadly properties of which she must have been perfectly acquainted. If the acid were taken medicinally, and an overdose swallowed by accident, it is singular that the bottle should have been found in her hand; since we cannot suppose that any well-informed person would take prussic acid medicinally, by swallowing it from the bottle itself. In consequence of the omission to inspect the body, it is difficult to say whether this was an act of suicide or the result of accident.

TREATMENT.—There is no known antidote to this medicine. Experience justifies us in employing stimulants, such as diluted ammonia, to the nostrils, and frictions of the compound camphor liniment to the chest. Chlorine has been strongly recommended to be injected in the state of solution into the stomach; but admitting that it were at hand to be administered in a case of poisoning which seldom lasts above a few minutes, it is a remedy of very doubtful character. It has been proposed to apply electricity in the course of the spinal marrow; but the best remedy, and that which is always applicable, is cold affusion. In experiments on animals this has been found an efficacious mode of treatment, and also in one case in the human subject which is reported by Dr. Banks of Louth. A girl took by mistake in medicine, thirty drops of prussic acid. Immediately afterwards, she sprang up convulsively from her seat, and became senseless. Her teeth were firmly set, and her eyes staring and fixed. Stimulants failed to rouse her:—the limbs became flaccid;—the pupils dilated, and she was wholly insensible;—the respiration was slow, and the pulse scarcely perceptible. A stream of cold water from a pitcher was allowed to fall from some height on the region of the spine. In a minute she began to move, and became convulsed; her symptoms abated, and in a few hours she was quite collected. She recovered in a few days, but there is hardly a doubt that she would have died, had she not been thus treated.

CHEMICAL ANALYSIS.—Prussic acid, as it is commonly met with, is limpid like water; it possesses an odour, not at first very perceptible, somewhat resembling that of bitter almonds. This odour is sufficient to produce giddiness and insensibility, especially when the acid is concentrated. Tho liquid has a very faint acid reaction, only just reddening litmus paper. The tests for its presence are, 1. The odour, which is said to be peculiar, although the compound called nitro-benzine possesses an odour so similar as to be easily mistaken for it. This odour may be present when the other tests completely fail to indicate the presence of prussic acid in a liquid, (See Oil of Bitter Almonds, post.) If the quantity of poison be small, and it remain exposed to the air for some time, the odour may entirely disappear, as it is of a very volatile nature. 2. Nitrate of Silver.—This will give, with prussic acid, a dense white precipitate, speedily subsiding in heavy clots to the bottom of the vessel, and leaving the liquid almost clear. The precipitate is identified as cyanide of silver by the following properties:—*a*, it is insoluble in cold nitric acid, but forms an opake solution on boiling: *b*, it is soluble in a large excess of solution of potash (care being taken that some free hydrocyanic acid is present): by this property the precipitate from prussic acid is eminently distinguished from the chloride, oxalate, and all the other salts of silver; it is also soluble in ammonia, but this is by no means a distinctive character, and therefore is unimportant: *c*. this precipitate, when dried and heated in a small reduction tube, yields cyanogen gas, which may be burnt at the mouth with a rose-red flame and blue halo. This is a well-marked character, and at once identifies the acid, which yielded tho precipitate, as prussic acid. I have ascertained by experiment, that in a small tube, three-fourths of a grain of the precipitate, which is equal to about eight drops of the common acid, will furnish good evidence; and that one-third of a grain is the limit for this decomposition; but by this quantity we can determine the presence of less than the 25th part of a grain of anhydrous acid. 3. The production of Prussian blue from the acid. For this purpose we add to the liquid a few drops of potash and of solution of green sulphate of iron. A dirty green or brownish coloured precipitate falls; on shaking this for a few minutes, and then adding diluted muriatic or sulphuric acid, the liquid becomes blue; and Prussian blue, of its well-known colour, unaffected by diluted acids, subsides. The same result is obtained, by adding the solution of tho iron salt to the potash solution of the cyanide of silver; and thus in this way, the three tests may be applied to only one portion of the poison.

Objections.—Somo remarks have been already made on the evidence derivablo from the odour—it cannot be relied on, unless other facts be forthcoming; although in one case, where moral circumstances were strong, a court of law accepted it as the only evidence of tho presence of the poison. With respect to the silver test, numerous acids are precipitated white by it, but the precipitate obtained from prussic acid only, possesses the properties above described; and unless these properties are demonstrated, no evidence from the application of this test, should be admitted as satisfactory. The production of Prussian blue from the green sulphate of iron, is peculiar to prussic acid, and is free from all objection. I have found this test to act in cases where the nitrate of silver gavo no precipitate, and only a faint cloudiness.

In organic mixtures.—The contents of the stomach commonly have a strong odour of this poison, and this has been perceived so late as seven days after death, in the well known case of Ramus; (Ann. d'Hyg. 1833, 336;)—but it may be concealed by other odours. If the odour be altogether absent, there will not be much probability of any of the poison being discovered.

The liquid of the stomach should be separated by filtration from all insoluble matters, and the cavity of the organ may be well washed with a small quantity of water and alcohol. As trial tests, one of the following plans may be adopted: 1. A portion of the liquid should be placed in a wide watch-glass, and another containing nitrate of silver inverted over it. If this, after a short time, becomes milky, and the milkiness disappears on adding caustic potash, it is possible that prussic acid is present. 2. Dip a slip of filtering paper in potash, then in the liquid, so as to fix any portion of acid; now transfer it to a saucer, containing a solution of green sulphate of iron, and lastly, to one containing dilute muriatic acid; if prussic acid be present, Prussian blue will be formed and deposited in the paper.

Should one or both of these tests indicate the presence of the acid in some quantity, the organic liquid may be distilled at a gentle heat, (150°,) and about one-eighth of the contents of the retort collected in a receiver kept cool by water. The tests may now be applied to the distilled liquid. If the trial tests indicate that the quantity of poison is small, a solution of nitrate of silver should be placed in the receiver to fix the acid as it distils over; cyanogen and Prussian blue may then be procured from the cyanide of silver in the way described. Prussic acid has been found by this process in the stomach, so late as seven days after death; but I believe this is the longest period at which it has been discovered—the poison soon passing off, owing to its great volatility. It has been alleged, that prussic acid might be generated from animal matter during the distillation, but this does not appear, chemically speaking, possible; and if the trial tests indicated the presence of poison before the distillation, the objection would not be even plausible. If muriatic acid were present, it might distil over, and embarrass the results. It has been recommended when the liquid is highly acid, to neutralize by potash; and add tartaric or acetic acid before distilling, so that nothing but prussic acid might pass into the receiver. If an alkali is suspected to be present, as ammonia, from putrefaction, it is advisable to add sulphuric acid, before commencing the distillation.

Is the discovery of prussic acid in the stomach of a person, a proof of death having been caused by it? As a general rule, we should be justified in answering this question in the affirmative. It has been said the poison might be introduced after death; but if such improbable speculations as these are to rule medical evidence, no certainty can ever be obtained. We do not here meet with the objection which applies to most other poisons, that the patient may have been cut off by disease after taking it, since if it operate fatally at all, it is in the course of a few minutes. Latent diseases of the heart and brain might, it is true, by a coincidence, cut short life; the circumstances of the case may, however, be such as to remove a supposition of this kind. So where two or more poisons are found in the stomach, and one is prussic acid, there can be no reason to hesitate in assigning death to the latter. In a case which occurred in 1837-8, prussic acid and arsenic were found in the stomach after death. In another, communicated to me by Mr. Clarkson, formerly a pupil at Guy's Hospital, the mixture taken by the deceased, consisted of brandy, opium, arsenic and prussic acid. The witness must therefore be prepared for these cases of compound poisoning, and the questions arising out of them. Prussic acid, according to the quantity discovered, must not only be regarded as the cause of death, but as the poison last taken, unless there is reason to suppose that the whole of the poisons were swallowed in one mixture.

It has been a question, whether prussic acid can be detected in the blood of persons poisoned by it. There is no doubt that in protracted cases, it is freely exhaled from the lungs, as it is very perceptible in the breath. Dr. Lonsdale states, that the odour cannot be perceived in the blood or cavities of the body, when life is prolonged beyond fifteen minutes. Krimer is said to have discovered prussic acid in the blood of an animal which died in thirty-six seconds; the analysis was made by distilling that liquid to dryness; but this, I believe, is the only instance in which the poison has been detected in the blood.

QUANTITATIVE ANALYSIS.—It is sometimes a matter of great importance, to ascertain the strength of the acid taken; and it is much more satisfactory to determine this point by chemical processes, than by giving the poison to dogs or rabbits, and noting how long a time it requires for a certain dose to destroy life. In performing this experiment, we must precipitate a weighed quantity of the acid entirely, by solution of nitrate of silver, and wash and dry the white cyanide of silver, obtained. One hundred grains of cyanide of silver are equivalent to 20·14 grains of anhydrous prussic acid; this is in the proportion of about one-fifth, so that the weight of the dried cyanide, divided by five, gives the quantity of anhydrous prussic acid. According to what was stated at the commencement of this chapter, one hundred grains of Scheele's acid should yield twenty-five grains of cyanide of silver, one hundred grains of Vanquelin's acid fifteen grains, and the same quantity of the London pharmacopœial acid ten grains.

OIL OF BITTER ALMONDS.—The bitter almond itself is a poison, and it owes its poisonous properties to prussic acid. It is, however, a remarkable fact, that none of the acid exists ready formed in it, nor is the poison ever produced except by the agency of water on the almond pulp. Thus the very act of mastication produces from this pulp, the poison which destroys life. There are one or two cases on record, wherein the almonds, when eaten in large quantity, have led to fatal symptoms and death. The essential oil, has given rise to a great number of accidents, and has caused toxicologists to direct their attention to it. Its poisonous properties are entirely due to the presence of hydrocyanic acid, which is intimately combined with it. Five pounds of the almonds are said to yield about half an ounce of the oil, and the quantity of hydrocyanic acid contained in it, varies from eight to fourteen per cent. (Christison.) It must, therefore, be regarded as an active poison. Its effects on the human subject will be best understood from the following cases.

A man, aged forty-eight, swallowed two drachms of the ethereal oil of bitter almonds. In a few minutes afterwards, he was found by his servant with his features spasmodically contracted, his eyes fixed, staring and turned upwards. The chest was expanded convulsively and hurriedly. In twenty minutes he was insensible, the pupils immoveable, the breathing slow and stertorous,—the breath having a strong odour of bitter almonds, and the pulse feeble. He died half an hour after he had taken the poison. On inspection, the whole of the body, and the blood which escaped, smelt strongly of bitter almonds; the teeth were fixed, the lips pale, fingers contracted, and the nails blue. The mucous membrane of the stomach and intestines presented an inflammatory redness, and there was turgescence of the brain. The blood, bile, and the muscles, had a deep violet colour. (Ed. Med. and Surg. Jour. xxii. 232.)

The following case occurred to Mr. Chavasse, of Birmingham. A druggist swallowed by mistake half an ounce of "almond flavour" In half a minute he fell down in a state of syncope: his face being deadly pale, and his pulse imperceptible. After a few minutes, he came to himself and vomited some undigested food and bile, strongly impregnated with the odour of bitter almonds. Delirium, with slight convulsions came on; he then became sensible, and conversed upon his condition; but again gradually relapsed into delirium, his eyes being prominent and brilliant. In a few minutes, he again became sensible, and slowly recovered from the effects of the poison. The quantity of "almond flavour" which he had taken, was estimated to contain about half a drachm of the essential oil.

I cannot avoid remarking, that we have here another instance of the disgraceful state of medical police in this country, in the fact that a deadly poison like this, is allowed to be sold by confectioners and others for the purpose of giving flavour to pastry and liqueurs.

The above case shows us, that thirty drops of the essential oil, have been taken without destroying life, although the patient had a very narrow escape.

Is the vapour of this oil sufficient to produce fatal effects? This question was raised in the subjoined case, which occurred in London, in 1838. The deceased, the wife of a publican, had been clearing out a closet which contained among other liquors, a bottle of the essential oil of bitter almonds. She was suddenly heard to call out. A servant found her pale and faint, and she complained of sickness. There was a strong odour in the room, and deceased said that the corks of some of the bottles had come out, and the smell had made her feel sick. She was removed to bed, but died before any medical assistance could be obtained. There was no motive for the deceased committing suicide, and it was a matter of inquiry at the inquest, whether the vapour alone might not have caused the death. This question was set at rest by an inspection of the body; some of the poison was found in the stomach, and there was a very strong odour of bitter almonds in the contents. It was, therefore, clear that the deceased must have swallowed a portion of the poison, whether from motives of curiosity or not, it is impossible to say. The medical witness properly stated, that less than a tea-spoonful might cause the death of an adult.

The vapour may produce vertigo and stupor; but unless long respired, it would not be likely to cause fatal effects. In 1837-8, there were four cases of poisoning by this oil. This poison is often sold under the name of peach-nut oil.

A case of poisoning by the oil of bitter almonds occurred at Hornsey, in February 1843, which shows that when the person is seen soon after death, there may be no odour about the mouth; and that an inspection is absolutely necessary in order to determine the cause of death. A chemist was found one morning, lying dead on the floor of his shop. The surgeon, who was first called, a few hours after death, suspected that the deceased had taken poison, because he saw on a shelf near the body, a bottle which had contained essential oil of bitter almonds. There was, however, no odour about the mouth, and this led to the opinion, that the deceased had died from disease of the heart. The body was subsequently inspected, and it was soon rendered evident from the powerful odour which escaped from the cavities, that the deceased had died from the effects of the oil of bitter almonds. All the viscera were in a healthy state. (Med. Gaz. April 7, 1843.)

Another case of poisoning by this oil occurred at Guy's Hospital in May 1843. A boy, aged twelve, was accosted by another in the street. The latter had a medicine basket on his arm, and from this he took a bottle and offered to the boy some liquid which he called almond oil. The boy thought that he swallowed about a table-spoonful; he experienced shortly afterwards a burning sensation in his throat, and in about ten minutes, he sat down on a door-step, and became insensible. About eight minutes after he was thus found, he was brought to the hospital. His breath smelt strongly of prussic acid; there were violent tetanic convulsions, with complete opisthotonos; the head and neck being drawn backwards, the elbows drawn behind his back, and firmly fixed in that position. The jaws were quite fixed; there was complete insensibility, and the pulse was scarcely perceptible. The treatment consisted in cold affusion to the spine and the use of the stomach-pump. The stomach was well washed out with a large quantity of water, and this smelt strongly of prussic acid. During the treatment, the patient suffered from strong convulsive twitchings of the muscles In about an hour he recovered, and left the hospital in the course of a few hours afterwards. It is very probable that in this case, the boy swallowed a portion of what is called almond flavour, a diluted solution of the essential oil. The contents of the stomach were submitted to two distillations, and about four ounces of a clear liquid, smelling strongly of bitter almonds, were procured. This liquid was scarcely rendered cloudy by nitrate of silver, and the iron test gave no trace of Prussian blue. The only proof, therefore, of the nature of the poison, was, the odour, which was very powerful, notwithstanding the want of action in the tests.

CHEMICAL ANALYSIS.—This oil has a pale yellow colour, and a strong odour of bitter almonds, by which it is at once identified. It gives a greasy stain when dropped on paper, which does not entirely disappear on the application of heat. It sinks in water and readily combines with alcohol; and the only test required, is to add to the alcoholic liquid, a small quantity of caustic potash, and a solution of green sulphate of iron. Prussian blue is formed on agitating the mixture, but is not well brought out, until any precipitated oxide of iron is dissolved by the addition of dilute sulphuric or muriatic acid. Water will separate a small portion of prussic acid from the oil. Thus, by agitating in a tube about one drachm of the oil, with three or four drachms of distilled water, and after a few minutes, filtering through a wet filter, the oil is entirely separated. The liquid which passes through is scarcely acid; it is rendered cloudy by nitrate of silver, and gives a decided blue-coloured precipitate with the sulphate of iron and caustic-potash. The oil and prussic acid may be more completely separated by distillation with lime and water, although it is probable that all the prussic acid is not obtained by this process. Nevertheless, if the oily product of the distillation be filtered through a wet filter, a clear aqueous liquid is obtained, giving an abundant precipitate with the silver test, and well-marked effects with the sulphate of iron and potash. It is remarkable, that the filtered liquid, after entire precipitation by nitrate of silver, has the odour of bitter almonds as strongly as before; and that the water holds some organic matter, is proved by the surplus nitrate of silver causing it to assume a violet tint, when it is exposed to the light of the sun.

NOYAU, CHERRY RATAFIA, and all liqueurs having the smell of bitter almonds, are poisonous when taken in large doses. The quantity of prussic acid present in them, is liable to vary; it may be separated by distillation at a gentle heat and then tested.

LAUREL-WATER. CHERRY LAUREL-WATER.—This is a very weak solution of prussic acid, containing only about one-fourth of a grain per cent. of the strong acid. In some specimens, which I procured by distilling the bruised tops and fine shoots of the laurel with water, the proportion of prussic acid present was considerably less than this. It is a limpid colourless liquid, possessing a strong odour of bitter almonds, and producing, in large doses, the usual effects of poisoning by prussic acid.

By distillation, the leaves of the plant yield also an essential oil, resembling that of the bitter almond, but much weaker, as it contains less than three per cent. of prussic acid. According to Christison, almost every part of the plant is poisonous, but especially the leaves, flowers, and kernels; the pulp of the cherry is not poisonous. Articles of food are often flavoured with the leaves, but accidents are said to have arisen from this practice.

We seldom hear of cases of poisoning by laurel-water. In a former part of this work, I have referred to the memorable trial of Captain Donellan, in 1781, on a charge of poisoning Sir T. Boughton, by this liquid.

The prisoner, it is supposed, substituted for a purgative draught, two ounces of laurel water. Admitting that the laurel water had no greater strength than that just now assigned to it, the deceased must have taken 2·4 grains of pure hydrocyanic acid, a quantity equal to *fifty drops* of Scheele's prussic acid. The draught was administered to the deceased by his mother, Lady Boughton; she perceived that it smelt strongly of bitter almonds—the only evidence of the probable nature of the poison; for the original draught, containing rhubarb, jalap, spirits of lavender, and nutmeg water, would have had no such smell. The following were the symptoms: "In about two minutes after swallowing the draught, the deceased appeared to struggle very much, as if to keep it down, and had 'a rattling and guggling' at his stomach. In about ten minutes, he seemed inclined to doze, and in about five minutes afterwards, he was found with his eyes fixed upwards, his teeth clenched, and froth running out of his mouth." He died in half an hour after swallowing the draught. The post-mortem examination proved nothing (antè, p. 57); no poison was detected in the body, but the inspection was not made until eleven days after death.

In making every allowance for such coincidences, in the supervention of fatal disease at the time of taking medicine or food, as have elsewhere been pointed out, I do not think there is any reason to doubt that in this case the deceased was poisoned and the prisoner properly convicted. It has been urged that the medical evidence was of itself insufficient; and that without the moral circumstances, the charge of poisoning could not have been made out. But it is impossible to divide evidence in this way; it is like separating two series of circumstances in presumptive evidence, either of which taken by themselves may be weak, but taken together, they become strong. Many convictions on medico-legal trials for murder by poisoning, would not have occurred if the fact had rested on moral or on medical evidence alone. In Donellan's case, the medical evidence was strong, whether we regard the time of the occurrence of symptoms, their character, or the period within which death took place. To exclude all notion of these effects depending on a draught just before taken, and having the decided odour of a liquid known to be capable of producing them; an odour which the originally prescribed draught could not possibly have had,—and to refer them to a disease, unusual in so young a subject, and unlikely to have caused death so rapidly, or under the symptoms witnessed, is to create impunity for the cunning and skill often displayed in murder by poison. Direct evidence can rarely be obtained in such cases; the murderer, unless insane, does not proclaim to the world his intention to poison another, nor the nature of the poison used, nor does he administer it openly. Every minute circumstance, therefore, requires the closest watching and analysis, if we wish to prevent by punishment, this most detestable crime. In several cases, which have occurred since that of Donellan, the medical evidence of poisoning has not been stronger; but taken, as it always ought to be, with moral circumstances, it has been held sufficiently strong by courts of law for a conviction of the accused party.

The following is the only recent case of poisoning by laurel-water, which I have found reported. About half a teaspoonful of a mixture, consisting of four-fifths cherry-laurel water, was given by mistake to an infant eight months old. The child threw its head back, was convulsed, and died in a few seconds. The laurel-water taken in this case, is said to have been stronger than usual. The body was inspected twenty-four hours after death. Nothing was observed in the brain and spinal marrow, but the stomach contained two tea-spoonfuls of a yellowish liquid without odour; and its mucous membrane was injected towards the greater curvature. No trace of prussic acid was found in the contents, but the poison was easily detected in the liquid remaining in the phial. (Med. Gaz. Jan. 1843.)

There are other plants, the leaves and kernels of which contain prussic acid; but these, it is unnecessary to specify.

SULPHOCYANIC and FERROCYANIC ACIDS, free or combined with potash, are said not to be poisonous, but further experiments are required on this point. A singular case, in which sulphocyanic acid was alleged to have been the cause of death, will be found in the British and Foreign Medical Review, July 1839. A man wishing to destroy himself, swallowed a liquid, which he had obtained by distilling strong sulphuric acid with ferrocyanate of potash. He was found dead in his room, and twenty-four hours afterwards, the body was examined. The stomach was not inflamed, but part of its mucous surface was softened, and of a brownish black colour. There was no odour of prussic acid. Some doubt being entertained, as to what the products of such a distillation might be, experiments were performed; but the results obtained by the different experimentalists did not agree. In repeating the distillation, I have found that prussic acid in large, and sulphocyanic acid in small quantity, were procured; and it is highly probable, that death was really caused by prussic acid, which may have been the case, although no odour was perceptible. The blackened state of the stomach was probably due to some sulphuric acid being mixed with it.

CYANIDE OF POTASSIUM.—This is a poisonous salt, now much used in the art of electro-gilding and plating. It is a solid, sometimes seen crystallized, at other in a white chalky-looking powder. It is without odour until put into water, when it is freely dissolved, forming an alkaline solution, from which prussic acid is abundantly evolved.

The cyanide of potassium is used on the continent as a medicine, and it has lately occasioned the death of a person at St. Malo, under the following circumstances.

A physician prescribed for the deceased, one drachm of the cyanide in two ounces and a half of orange-flower water and syrup; and of this mixture, three spoonfuls were to be taken daily: it seems that table-spoonfuls were taken, and the patient died in three quarters of an hour after the first dose. None of the poison was found in the stomach; but a portion of the mixture from which the first dose had been taken was examined, and found to contain the cyanide of potassium. A criminal procedure was instituted against the physician, and he was fined and imprisoned. M. Malaguti, who gave evidence on the occasion, stated that a dog was killed in a few minutes after taking less than three grains of the cyanide in solution, and that the largest dose of this medicine to a human being was five-sixths of a grain. (Lancet, January 1843.) The mixture in the above case, contained about three grains of the cyanide in one drachm: therefore had teaspoonfuls been taken by the deceased, he would have taken quite sufficient to destroy life. The medicine had evidently been prescribed by a person totally ignorant of its poisonous properties.

CHEMICAL ANALYSIS.—Cyanide of potassium is known, 1, by the odour of its solution in water, 2, by the action of nitrate of silver, which precipitates cyanide of silver soluble in excess, and 3rd, by tartaric acid or chloride of platina, which indicates the presence of potash. A solution of sulphate of iron and muriatic acid produce with it, Prussian blue. The recent introduction of this salt into the arts may easily lead to accidents. It must be regarded as highly poisonous.

PRUSSIAN BLUE.—This substance does not appear to possess any poisonous properties. It is said to be much employed, when mixed with some yellow colouring matter, to give a green colour to factitious tea-leaves. In a seizure which was lately made of some spurious tea, a question was put by the magistrate as to whether Prussian blue was a poison. One of the parties, who gave evidence, is reported to have said that it was a decided poison:—that it consisted of iron, nitrogen and carbon, and was strongly imbued with prussic acid! This evidence appears to have been received without any comment. Prussian blue is known from other substances of the same colour, by its becoming brown when heated, or when digested in a solution of caustic potash.

CHAPTER XXVII.

NARCOTICO-IRRITANT POISONS. NUX VOMICA. STRYCHNIA. COLCHICUM. VERATRIA. CONIUM. ALCOHOL.

The general symptoms produced by the narcotico-irritants, have already been described. (See Chapter III.) It will therefore be only necessary to make in this place a few remarks on some of these poisons individually.

NUX VOMICA. STRYCHNIA.—Cases of poisoning by nux vomica are not unfrequent. In 1837-8, there were three cases marked in the coroner's return, and one case of poisoning by strychnia. The poisonous properties of nux vomica are due to the presence of strychnia; the symptoms in the two cases are alike, but of course much more severe when produced by the pure alkaloid. Nux vomica is usually taken in the form of powder.

SYMPTOMS.—The powder has an intensely bitter taste, which is very persistent. In from five to twenty minutes after it has been swallowed, the patient is suddenly seized with tetanic spasms, affecting the whole of the muscular system, the body becoming rigid, the limbs stretched out, and the jaw so fixed, that considerable difficulty is experienced in introducing anything into the mouth. The muscles of the chest are also fixed by spasmodic contraction, and the body sometimes assumes the state of opisthotonos; the intellect is clear. This spasmodic state ceases, but after a short interval, reappears, and the chest is so fixed, as to give the sense of impending suffocation. After several such attacks, increasing in severity, the patient dies asphyxiated. Drowsiness and a feeling of general illness have sometimes preceded the attack; vomiting, pain in the abdomen, and other symptoms of irritation, have been occasionally witnessed where the case was protracted; but in general, death takes place long before such symptoms are manifested.

POST-MORTEM APPEARANCES.—In a well-marked case of poisoning by this substance at University College Hospital in 1839, the only appearances met with, were general turgescence of the brain and its vessels. A quantity of the powder was found in the stomach, to the mucous membrane of which it adheres very tenaciously; there was injection, with many ecchymosed points at the cardiac extremity. The brain, as well as the spinal marrow, has been found softened. The spasmodic condition of the body has been observed to continue after death, and to pass into the state of cadaverous rigidity.

With respect to the QUANTITY required to destroy life,—according to Christison, the smallest dose yet recorded, is three grains of the alcoholic extract; but it is not stated to how much of the powder this would correspond. Two cases occurred in London, in 1839, in each of which fifty grains of the powder (equal to one-fourth of a grain of strychnia) proved fatal. In one of these cases, death took place in an hour; the chemist who sold the poison said that he did not think a dose of fifty grains was sufficient to cause death; but there is no doubt that even a smaller quantity might kill. One case proved fatal, where thirty grains of the powder were taken in two doses. Death usually takes place in from one to two hours. There are several instances of recovery on record. Sobernheim mentions the case of a young man, who took half an ounce of the powder, and suffered from the usual symptoms; emetics were administered, and he recovered. A second occurred to Dr. Basedow, of Merseburg. A young lady swallowed, by mistake, a tablespoonful of the powder; she was almost instantly deprived of the power of walking, and fell down, but did not lose her recollection. There was great difficulty of breathing. Emetics were administered with good effect, and she recovered. A third case is described by Mr. Baynham, of Birmingham. A girl aged twenty, swallowed half an ounce of the powder. In half an hour the usual tetanic symptoms came on, but she was perfectly sensible. In administering remedies, the spasm of the muscles of the jaw was such as to cause her to bite through the cup. The convulsions gradually subsided in about four hours from the first attack, and the next day, although feeble and exhausted, she was able to walk home. (Med. Gaz. iii. 445.) The reporter of this case states that he has often prescribed a scruple of powdered nux vomica daily, without any injurious effects following.

TREATMENT.—The removal of the poison from the stomach by emetics, or the use of the stomach-pump, must be chiefly relied on. Unless these means be employed early, the jaw may become spasmodically fixed, so as to render all efforts at relief unavailing. In general, however, the spasms have intermissions, so that there may be time to apply remedies in the interval. Mr. W. Ley, of Crawford-street, has lately recommended as an antidote, what promises to be a powerful remedy, namely, the extract of the cannabis Indica, which, while it acts as a sedative, and produces the most complete relaxation of the muscular system, does not expose the patient's life to danger, even when given in a large dose. (Provincial Medical Journal, Aug. 1842, and March 1843.)

STRYCHNIA AND ITS COMPOUNDS.—The symptoms produced by strychnia, closely resemble those described in speaking of nux vomica. The following case is reported in the Lancet, (Jan. 7, 1838.) A young man, aged seventeen, swallowed forty grains of strychnia. The symptoms came on in about a quarter of an hour; trismus and spasmodic contraction of all the muscles speedily set in; the whole body becoming as stiff as a board; the lower extremities were extended and stiff, and the soles of the feet concave. The skin became livid, the eyeballs prominent, and the pupils dilated and insensible; the patient lay for a few minutes without consciousness, and in a state of universal tetanus. A remission occurred, but the symptoms became aggravated, and the patient died asphyxiated from the spasm of the chest, in about an hour and a-half after taking the poison. On inspection, twenty hours after death, the body was very rigid. There was effusion in the spinal sheath, and the upper part of the spinal marrow was softened; the brain was congested, but the alimentary canal was in its normal state.

With respect to the *quantity* of strychnia required to destroy life, Dr. Christison thinks that half a grain thrust into a wound, would destroy a man in a quarter of an hour. Three-eighths of a grain given medicinally, produced violent tetanic convulsions, spasms of the extremities, trismus, opisthotonos, spasmodic fixing of the chest, and all the other formidable symptoms usually produced by the alkaloid. (Ed. Med. Surg. Jour. 49, 327.) Thus we see that this substance, which is almost insoluble, requiring seven thousand parts of water to dissolve it, is capable of exerting a powerfully poisonous action. The quantity required to destroy life when swallowed, is not known. My friend, Mr. J. G. French, informed me of a case, where a person took medicinally a grain of strychnia; vomiting supervened, and in the course of a few hours she recovered. This must be regarded as an unusually large dose, to be followed by recovery, since it is very probable that half a grain might in some cases prove fatal.

The symptoms produced by strychnia very much resemble those of tetanus, but in the last-mentioned disease the symptoms are more slowly formed, and can only be accidentally connected with the taking of some kind of solid or liquid. Death is a much more rapid effect of the poison, than of the disease, where dependent on other causes. Medical men may, however, be easily deceived as to the origin of the symptoms, when the dose is small and frequently repeated. A few years since, an action was brought against an insurance company, to recover the amount due on a policy for the life of a young lady. She died under very suspicious circumstances after several insurances on her life had been effected by the plaintiff in the cause. The party did not recover in the action, and he ultimately fled the country; it was ascertained afterwards that he had destroyed the deceased by administering to her strychnia in porter.

The Bean of St. Ignatius and the Upas tieuté, owe their poisonous properties to this alkaloid. The former is said to contain from 1·2 to nearly 2. per cent of strychnia, a quantity three times as great as that found in nux vomica.

CHEMICAL ANALYSIS.—Nux vomica is well known as a flat round kernel, less than an inch in diameter with radiating fibres, slightly raised in the centre. It is of a light brown colour, and covered with a fine silky down. It is very hard, brittle, tough, and difficult to pulverize. The powder is of a grey brown colour, like that of liquorice:- it has an intensely bitter taste. It yields to water and alcohol strychnia, brucia, igusuric or strychnic acid, and some common vegetable principles. Heated on platina foil, it burns with a smoky flame. Nitric acid turns it of a deep orange-red colour, which is destroyed by protochloride of tin. The aqueous infusion is similarly changed by nitric acid, and is freely precipitated by tincture of galls. The quantity of strychnia contained in the powder is not very accurately determined. It probably amounts to about 0.5 grain or one-half grain per cent. If this be the case, the strychnia is more energetic when contained in the nut, than when separated.

If nux vomica has been taken in powder, we can only identify it in the stomach by demonstrating the presence of its strychnia. As the powder is quite insoluble in water, it may generally be separated by decantation.

Various processes have been suggested for the detection of strychnia in nux vomica; but owing to the very small quantity of the poisonous alkaloid contained in it, it is obvious that, unless we have a large quantity of the powder to examine, none of these are likely to succeed. Fifty grains of the powder will not yield more than one quarter of a grain of strychnia. The following is, perhaps, the most simple process: Boil the powder in alcohol of about seventy per cent., until nothing further is dissolved. Evaporate to an extract, and boil this in water with a small quantity of calcined magnesia. Strychnia, mixed with brucia, is thereby precipitated; and may be separated from the magnesia in the insoluble residue, by further digestion in boiling alcohol. This alcoholic liquid yields strychnia, which may be purified in the usual way. There are no chemical characters by which the acid, united to the strychnia, can be readily identified; and thus this process is more defective than that for morphia, since we acquire so much more certainty, where, besides the poisonous base, we can show by tests the presence of the peculiar acid with which the base is known to be united. Another method of separating strychnia, is by making an aqueous infusion with very dilute sulphuric acid, and afterwards precipitating the strychnia by boiling the filtered liquid with lime. The aqueous infusion of nux vomica gives the same bright red tint with nitric acid, as the infusion of opium; but it is known from the latter by its giving a green instead of a deep red colour with the permuriate of iron.

Strychnia is known by the following properties: 1. It may be met with crystallized in short prisms, or in the state of a greyish white powder. 2. It is scarcely soluble in water, hot or cold;—it is not very soluble in alcohol, but is dissolved by ether. 3. When heated on platina foil, it melts, becomes charred, and burns with a black smoky flame, leaving a residue of carbon. This experiment should be performed with caution, and on the smallest quantity;—if the vapour be respired, it might give rise to alarming symptoms. 4. When the crystals are dropped into strong nitric acid, they become partially dissolved, without evolving deutoxide of nitrogen, and the liquid acquires a deep red colour. This colour is immediately destroyed by protochloride of tin; but if allowed to remain exposed to air, it slowly changes to a dark greenish brown. This red colour, thus given by nitric acid, appears to be caused by the presence of brucia. I have, however, found it to be produced in all the specimens of uncombined strychnia which I have tried; and it is pretty certain, that no specimen of strychnia is ever likely to come before a medical jurist in practice, which does not possess the property of being turned red by nitric acid. 5. If to strychnia in water a few drops of a dilute acid (sulphuric) be added, it is readily dissolved on boiling, crystals being sometimes deposited on cooling. 6. This solution is precipitated by tincture of galls. 7. It is precipitated white by alkalies (ammonia). 8. It is precipitated yellow by chloride of gold, while a salt of morphia gives with this test a purple brown precipitate. 9. It is coloured red by nitric acid;—the colour being discharged by protochloride of tin. 10. It is not affected by permuriate of iron, by iodic acid and starch,—characters whereby it is easily known from morphia.

Colchicum. White hellebore. (veratria.) The roots and seeds of these plants exert a violent action on the human subject, chiefly manifested by symptoms of irritation in the alimentary canal. With a burning pain in the throat and œsophagus, there have been violent vomiting and purging, and death in the course of some hours. After death, the stomach has been found inflamed, but not in all instances. In November, 1839, a gentleman swallowed by mistake one ounce and a half of wine of colchicum. He was immediately seized with severe pain in the abdomen; other symptoms of irritation came on, and he died in seven hours. No post-mortem examination was required by the coroner. In a well-marked case of poisoning by the wine of colchicum, reported by Mr. Fereday, two ounces were taken. The symptoms did not come on for an hour and a half; there was then copious vomiting of a yellow fluid, severe pain with great tenderness in the abdomen, tenesmus and thirst. The patient died in forty-eight hours without manifesting any sign of cerebral disturbance. The chief morbid appearance was a patch of redness in the mucous membrane of the stomach, near the cardiac orifice; the intestines were slightly inflamed. In another case, where an ounce and a half of the tincture was taken, and death ensued in forty-eight hours, no morbid appearances were found.

A man, aged fifty-two, took a decoction, made with a tablespoonful of colchicum seeds to a pint and a half of water. He was seized with vomiting and purging continuing incessantly until death, which took place in about thirty-six hours. The only appearance of note, was that the stomach had a violet or purple hue.

Colchicum and white hellebore owe their poisonous properties to the alkaloid veratria, which is a powerful poison when separated. But little is known concerning its action. A medical friend communicated to me the following fact. A physician prescribed medicinally for a lady one grain of veratria divided into fifty pills, and three were directed to be taken for a dose. Not long after the first dose had been swallowed, the patient was found insensible, the surface cold, the pulse failing, and there was every symptom of approaching dissolution. She remained some hours in a doubtful condition, but ultimately recovered. Supposing the medicine to have been well mixed, and the pills equally divided, not more than one sixteenth of a grain of veratria was here taken. This, at any rate, proves, that the substance is a very active poison.

Digitalis. (Foxglove.)—This plant, whether in the form of powder, extract, tincture, or infusion, is a poison, acting both on the brain and alimentary canal. One of the best marked cases of poisoning by this plant, was the subject of a criminal trial at the Old Bailey in Oct. 1826. A quack was indicted for the manslaughter of a boy under the following circumstances. He prescribed for a trivial complaint, six ounces of a strong decoction of digitalis. The boy was soon attacked with vomiting and purging, and severe pain in the abdomen. After some time, he became lethargic and slept for several hours; in the night he was seized with convulsions. The pupils were dilated and insensible, the pulse slow, small, and irregular; coma followed, and the boy died twenty-two hours after the taking of the poison. On inspection, the membranes of the brain were found much injected, and the mucous lining of the stomach partially inflamed. The prisoner was acquitted of the charge, because he had only given his advice on the application of the friends of the deceased! (Ed. Med. and Surg. Jour. xxvii. 223.) Accidents sometimes occur from the medicinal use of the tincture. In a late number of the Medical Gazette, is the account of a case, where from a dose of the tincture too frequently repeated, the person was attacked with restlessness, thirst, inflamed conjunctivæ, and other serious symptoms.

CONIUM MACULATUM. (COMMON HEMLOCK.) CICUTA VIROSA. (WATER HEMLOCK.) ÆTHUSA CYNAPIUM. (FOOL'S-PARSLEY.) ŒNANTHE CROCATA, (HEMLOCK WATER-DROPWORT.)—The leaves and roots of these plants have frequently given rise to accidents. The symptoms which they produce, are dimness of sight, vertigo, delirium, swelling, with pain in the abdomen, vomiting and diarrhea. Convulsions are sometimes observed. Death commonly takes place rapidly, and the post-mortem appearances are slight; sometimes amounting merely to congestion of the brain, with slight inflammatory redness of the stomach and bowels. The œnanthe crocata appears to be the most fatal among these plants. In February, 1834, four convicts at Woolwich lost their lives by eating the roots of this vegetable, which they had mistaken for parsnips. On inspection, their stomachs were found completely filled with slices of the root. Ten others who had also partaken of the root suffered severely, but recovered. This is one of the most virulent of English vegetable poisons. It is found growing abundantly in the South of Ireland. Dr. Pickells has collected thirty cases of death from the eating of the root,—the quantity taken in one instance not exceeding the top of the finger in size. The symptoms were insensibility, tetanus, delirium, and insanity.

The following is a case of poisoning by the æthusa cynapium, reported in a late number of the Medicinisches Jahrbuch. A woman gave two of her children some soup, in which she had boiled the root of this plant, mistaking it for parsley. They were both seized with severe pain in the abdomen, and the next morning, one of them, a boy, aged eight years, was in a state of perfect unconsciousness, and his jaws were spasmodically fixed. The abdomen was swollen; there was vomiting of bloody mucus, with obstinate diarrhea,—the extremities were cold, and the whole body was convulsed. He died in twenty-four hours. The only appearances met with were redness of the lining membrane of the œsophagus and trachea, with slight vascular congestion of the stomach and duodenum.

DATURA STRAMONIUM. (THORNAPPLE.) The following case reported by Mr. Mash of Northampton, may be taken as an example of the effects produced by this plant, all the parts of which, but especially the seeds and fruit, are poisonous. A woman, aged thirty-six, took two teacupfuls of infusion of stramonium, by mistake for senna tea. In about ten minutes she was seized with giddiness of the head, dimness of sight, and fainting. In two hours she was quite insensible, the pupils were fixed and dilated; all the muscles of the body convulsed, the countenance flushed, and the pulse full and slow. The stomach-pump was applied, and in the course of a few hours she recovered, suffering, however, from indistinctness of vision and vertigo. (Med. Gaz. viii. 605.)

The seeds of this plant have been known to produce furious delirium; and a case is mentioned by Sauvages of an old man of sixty, who, after taking this poison, became intoxicated, maniacal, and lost the power of speech. He remained in a lethargic state for five hours. Several fatal cases are reported, one of which terminated in six hours. Dr. Thomson relates the case of a child, aged two years, who swallowed sixteen grains of the seeds. Maniacal delirium supervened, the symptoms resembled those of hydrophobia, and death took place in twenty-four hours. This plant has been used by robbers for the purpose of stupifying those whom they intend to attack.

A very interesting medico-legal case of poisoning by thornapple will be found reported in Henke's Zeitschrift der S. A. 1837, i. H.

ACONITUM NAPELLUS. (MONKSHOOD. WOLFSBANE. BLUE-ROCKET.) Two deaths are recorded to have taken place from this poisonous plant in 1837–8. The leaves and root appear to contain an active poison Both possess a hot acrid taste, and give rise to a burning sensation in the fauces, swelling and pain in the abdomen, vomiting and diarrhea, accompanied by vertigo, delirium, dimness of sight, and other symptoms, indicative of cerebral affection. In 1842, a lady, residing at Lambeth, was poisoned by her having eaten the root in mistake for horseradish with some roast beef. It is not likely, that under these circumstances, much could have been eaten; but very shortly after dinner slight vomiting came on, with severe pain in the abdomen. Emetics and the stomach-pump were used, but she died in three hours..

In the hospital at Bordeaux, five grains of fresh extract of aconite were given to three patients. One of them died in three hours. In a quarter of an hour after taking the poison, the patients had tremors of the muscles, and a pricking sensation over their bodies; severe vomiting followed. They became quite unconscious; and on recovering their senses, there was confusion of sight with intense headache; the skin was cold and clammy, the pulse slow and irregular, and the respiration short and hurried. Two of the patients recovered. (Med. Chir. Rev., Oct., 1839, 544.) The most complete medico-legal history of poisoning by aconite has been given by Dr. Geoghegan, of Dublin, in the Dublin Medical Journal.

A trial for murder by poisoning, took place at the Monaghan Lent Assizes in 1841, in which he was a witness for the crown. The medical evidence was beset with difficulties; for no trace of poison could be discovered, and it was only by a close analysis of symptoms and post-mortem appearances, that the charge was brought home to the prisoner. The deceased had eaten for his dinner some greens dressed for him by the prisoner; he complained of their having a sharp taste, and this was perceived also by another person present, who tasted them. It was ascertained, that the deceased, soon after the meal, had vomited a greenish matter, and suffered from diarrhea, restlessness, incoherence, trismus and clenching of the hands. He died in about three hours after having eaten the greens, but was not seen by a medical man while living. The chief appearance met with, was in the stomach, where the mucous membrane was of a light reddish brown colour. Traces of vegetable matter were found in the intestines: but no poison could be detected either botanically or chemically. The symptoms suffered by the person, who had accidentally tasted the greens, were very characteristic of poisoning by aconite. In *two* minutes he felt a burning heat in the mouth, throat, gullet and stomach; then a sensation of swelling in the face, a general feeling of numbness and creeping of the skin. Restlessness, dimness of sight and stupor, almost amounting to insensibility, followed; and about an hour after the meal, he was found speechless,—frothing at the nose and mouth, the hands and jaws clenched, appearing occasionally as if dead, and then again reviving. Vomiting, purging, tenderness of the epigastrium, cramps, tingling of the flesh, and a burning taste in the mouth, followed. He did not entirely recover after the lapse of five weeks. The prisoner was convicted of murder, and confessed before execution that the root of aconite had been mixed with pepper and sprinkled over the greens. From this case we learn that the actual discovery of a poison is not insisted on by a court of law, when the medical and general evidence is conclusive of the fact of poisoning. Dr. Geoghegan quotes two other instances of poisoning by aconite, one of a man aged fifty-six, who died in an hour and a quarter after eating the root;—and the second, a boy aged seven, who died in two hours, having been much convulsed before death. One drachm of the root is said to have proved fatal; but it is probable that less than this would suffice to kill an adult.

ATROPA BELLADONNA. (DEADLY NIGHTSHADE.) This plant is poisonous in its root, leaves, and berries. Children have frequently suffered severely from eating the shining black berries of the belladonna. The symptoms observed have been dryness of the throat and fauces,—vertigo, delirium, convulsions, sopor, and lethargy; sometimes vomiting and nausea exist. There have been but very few instances known of this poison proving fatal, consequently there are very imperfect accounts of the morbid appearances. It has been supposed that the delirium, produced by it, preceded the lethargic state; but from a case published by Mr. Clayton, where a man took forty grains of the extract and recovered, the sopor preceded the delirium, which did not come on until six hours after the administration of the poison. A case occurred at St. George's hospital, under Sir B. Brodie, in which an ounce of the extract of belladonna had been taken, and the person recovered. This is not, therefore, so active a poison as its common name would imply; it is much less virulent than some of the other narcotico-irritants. One death occurred from it in 1837-8.

NICOTIANA TABACUM (TOBACCO.) This plant contains a poisonous alkaloid—nicotia, possessing the characters of an essential oil. Tobacco has proved fatal, when used improperly or by mistake, in the form of an injection; but very little is known concerning the few cases in which it has destroyed life. The symptoms have been nausea, vomiting, vertigo, convulsions and coma, followed by death in a few hours. In one case it destroyed life in three quarters of an hour.

Cocculus Indicus.—This is the fruit or berry of the Menispermum Cocculus, imported from the East Indies. It contains about two per cent. of a poisonous alkaloid (picrotoxine.) The seeds give rise to vomiting, and a decoction of them produces intoxication. There is no well-authenticated instance of this substance having proved fatal to man. London porter and ale are considered, and, in some instances, with propriety, to owe their intoxicating properties to a decoction, or extract, of these berries, a fraud not readily susceptible of detection. Cocculus indicus is also used by robbers to intoxicate their victims, and to this form of intoxication the term hocussing is applied. This substance is applied to no useful purpose whatever, either in medicine or the arts, and, under a proper system of medical police its importation would be strictly prohibited.

Fungi. Mushrooms. Poisoning by mushrooms is by no means unusual as the result of accident. In 1837-8 there were four fatal cases of this description. There do not appear to be any satisfactory rules for distinguishing those mushrooms which are wholesome from those which are poisonous. Perhaps the best test is that assigned by Dr. Christison—namely, that the poisonous vegetable has an astringent styptic taste; and perhaps also a disagreeable but certainly a pungent odour. The poisonous principle is called fungin, but its nature and properties are but imperfectly known. These fungi act sometimes as narcotics, at others as irritants. It is difficult to generalize where observations are so limited; but it would appear from the reports of several cases which I have collected, that when the narcotic symptoms are excited, they come on soon after the meal at which the mushrooms have been eaten, and they are manifested by giddiness, dimness of sight and debility. Dr. Peddie has related three cases of poisoning by mushrooms, (Ed. M. & S. J. xlix., 200,) in which the poison acted as a pure narcotic; there was no pain in the abdomen, nor irritation in the alimentary canal. The narcotic symptoms began in half an hour with giddiness and stupor. The first effect with one patient was, that every object appeared to him to be of a blue colour. The three patients recovered, two of them rapidly. When the drowsiness passes off, there is generally nausea with vomiting. If the symptoms do not occur until many hours after the meal, they partake more of the characters of irritation;—indicated by pain and swelling of the abdomen, vomiting and purging. Several cases, in which the symptoms did not appear until after the lapse of fourteen hours, are reported in the Medical Gazette (vol. xxv. p. 110.) In some instances, the symptoms of poisoning have not commenced until after the lapse of thirty hours; and in these, narcotism followed the symptoms of irritation. It might be supposed that these different effects were due to different properties in the mushrooms; but the same fungi have acted on members of the same family in one case like irritants, and in another like narcotics.

In some persons, even the edible mushrooms will produce disorder of the stomach and bowels by the effect of idiosyncrasy. In most of these cases recovery takes place, especially if vomiting be induced:—in the few instances which have proved fatal, there has been more or less inflammation in the stomach and bowels, with turgescence of the vessels of the brain.

A case is related by Christison, which shows that a medical jurist may be easily misled where any active poison is mixed with and administered in a dish of mushrooms (779.) A servant girl poisoned her mistress, by mixing arsenic with mushrooms. This person died in twenty hours, after suffering severely from vomiting and colic pains. On dissection, the stomach and intestines were found inflamed. Death was ascribed to the effects of the mushrooms, which were considered to have been unwholesome; and the fact of poisoning only came out many years afterwards, by the confession of the prisoner. This shows with what a watchful eye such cases should be examined: in the absence of poison from the stomach, it would be extremely difficult to develope the truth.

Analysis.—Most of the narcotico-irritant poisons just considered, owe their deleterious effects to the presence of an alkaloidal principle, similar to morphia, and susceptible of insulation by complex chemical processes. There is, however, considerable difficulty in extracting these alkaloids from the respective vegetables; and when extracted, the chemical differences among them, in respect to the action of tests, are so slight, as to be scarcely appreciable, even in the hands of a practised analyst. Indeed, better evidence of their nature, would commonly be derived from the exhibition of a portion of the suspected substance to animals, than from the application of chemical tests. In a medico-legal point of view, there are at present no chemical tests for these poisons, upon which reliance can be placed. When the vegetable itself has been used, either in the shape of seeds, leaves, berries, or root, then good evidence may be sometimes procured, by searching for the botanical characters of the plant; these parts of the plant may be found in the vomited matters or evacuations during life, or in the alimentary canal after death. This source of evidence will, however, often fail, owing to the poison having been taken in fine powder,—in the form of extract, infusion or decoction, or even, in some instances, owing to the digestive action of the stomach itself on the vegetable matter. Some years since, I was consulted in a case, in which there was hardly a medical doubt, that the life of a person had been destroyed by the decoction of a narcotico-irritant vegetable. The fact, however, could not be clearly established. It is much to be regretted, that post-mortem examinations, are not enforced as an indispensable part of the coroner's inquest, at least in all instances of narcotico-irritant poisoning. There is no department of toxicology so defective as this; only a few pathological characters have been observed in cases, derived almost exclusively from foreign authorities; and in regard to the effects of some of these poisons on the human body, nothing whatever is known except that they destroy life. The acquisition of any sort of medical experience on these points, in England, is unfortunately left to be a matter of the purest accident; and yet on a trial for murder by any of these poisons, our law authorities would expect that a witness should be perfectly conversant with their effects on the body, while the only possible source of acquiring such knowledge in a satisfactory manner, is entirely cut off from the medical profession. Some well-informed coroners have endeavoured, in performing their duties, thus to benefit the public; but the generality of them act on the principle that the inquest in such cases is merely to record the fact of death from an external view of the body.

The TREATMENT, in cases of narcotico-irritant poisoning, consists in promoting vomiting by emetics, or in drawing off the contents of the stomach by the stomach pump. If there should be reason to suppose from the seat of pain, that the poison has descended into the bowels, then laxative enemata may be used. Recoveries have taken place when the poison has been thus removed, even although formidable symptoms had set in. Cold affusion, or stimulants, may occasionally be required:—the patient, if inclined to sleep, should always be kept roused. There is no antidote to any of these poisons.

The narcotico-irritants appear to have no corrosive properties:—some of them give rise to a sense of burning heat in the throat and stomach,—this is a local action entirely independent of chemical change: it is especially witnessed in the case of monkshood.

CAMPHOR.—Camphor, perhaps, belongs rather to the narcotic than the narcotico-irritant substances, so far as its action on man is concerned. I have not been able to meet with any case in which it has caused death in the human subject; but it has on several occasions produced rather alarming symptoms, and would probably have destroyed life, had it not been removed from the stomach. In the few cases that have been observed, its effects were somewhat different, though all referrible to an impression on the brain and nervous system. It will be better therefore to give an outline of these individually, rather than to group the symptoms together.

The following case is reported by Mr. Hallett, of Axminster. A woman swallowed in the morning about a scruple of camphor dissolved in rectified spirits of wine mixed with tincture of myrrh. In half an hour she was suddenly seized with langour, giddiness, occasional loss of sight, delirium, numbness, tingling and coldness of the extremities, so that she could hardly walk. The pulse was quick and respiration difficult, but she suffered no pain in any part. On the administration of an emetic, she vomited a yellowish liquid, smelling strongly of camphor. In the evening, the symptoms were much diminished, but she had slight convulsive fits during the night. The next day she was convalescent; but the dyspnœa continued more or less for several weeks. The dose does not appear to have exceeded twenty grains,—the smallest dose which appears to have been attended with serious symptoms.

A man, aged thirty-nine, swallowed about thirty-five grains of powdered camphor, prepared for lozenges. In twenty minutes, giddiness and dimness of sight, came on; and he fell from a chair in a kind of epileptic fit, which lasted about ten minutes. The extremities were cold, the pulse frequent and scarcely perceptible:—when roused he had scarcely power to articulate. A quantity of a clear liquid, smelling strongly of camphor, was drawn off by the stomach-pump. The man did not recover for a week, suffering chiefly from general exhaustion and suppression of urine: this latter symptom continued more or less for three months afterwards. There was no disorder of the stomach or bowels.

Dr. Christison refers to a case where half a drachm of camphor given in an injection produced numbness of the scalp, and other nervous symptoms. In two other cases mentioned by him, in each of which forty grains had been taken, the symptoms were vertigo, chilliness, convulsive fits and delirium.

In larger doses, symptoms of irritation make their appearance. Dr. Siemerling of Stralsund, relates that a man, aged sixty-nine, swallowed two drachms of camphor, in order to relieve some rheumatic symptoms under which he was labouring. When seen three hours afterwards, he resembled a drunken person. He complained of burning heat in tbe mouth, throat, and stomach,—throbbing in the head, pains in the course of the spine and a ringing in the ears,—the appearance of a dazzling light before the eyes, and these symptoms were followed by subsultus tendinum, and insensibility. In this state, he continued for an hour and a half, perspiring profusely. Tho man slowly recovered; but none of the camphor appears to have been ejected from the stomach. (Wildberg's Jahbuch, 1837. 3 B. 4 h.)

In a case reported in the Medical Gazette, (vol. ii. 772,)—two drachms were taken by a physician, and all that he experienced was. lightness in the head and great exhilaration. There was no derangement of the stomach or bowels. He slept profoundly for some hours, and awoke very weak and exhausted. He also perspired greatly during his sleep. It is difficult to draw any conclusion from this case as the quantity taken was conjectural; and the patient was not seen by any person, while labouring under the effects of the poison.

The largest dose of camphor that has been taken, was in a case which occurred to Wendt, of Breslau. Eight scruples were swallowed by a drunkard, dissolved in spirit. The symptoms were vertigo, dimness of sight, delirium, and burning pain in the stomach. There was no vomiting: the man recovered. This case shows, that camphor cannot be regarded as a very active poison.

CHEMICAL ANALYSIS.—The camphor would probably be found in the state of lumps, or dissolved in spirit. No difficulty would occur in identifying this substance, except perhaps in a case where it had proved fatal and existed in the contents of the stomach Its presence would be immediately known by its powerful and peculiar odour. If it were diffused in the form of lumps or powder, these might be easily separated from the contents, owing to the great insolubility of this substance. In general, it might be expected that some portions would float to the surface of water. In a doubtful case the contents of the stomach should be treated with a large quantity of alcohol:—the alcoholic liquid filtered. and the camphor separated by adding water It is a white solid,—possessing a well known odour,—easily dissolved by alcohol, and again separated by water,—entirely volatile without residue, and burning with a rich yellow smoky flame.

ALCOHOL.—The only form of poisoning by alcohol, which a medical jurist has to encounter, is that which arises from the taking of large quantities of spirituous liquors, such as gin, whiskey, rum, and brandy. The two last-mentioned compounds contain about fifty-three per cent. by measure of alcohol, while gin and whisky are rather stronger, gin containing as much as fifty-seven per cent.

A large quantity of spirit has been known to destroy life suddenly, although such cases are rare. In general, the *symptoms* come on in the course of a few minutes. These are, confusion of thought, inability to stand or walk, and vertigo, followed by coma. Should the individual recover from this state, vomiting and sickness supervene. This form of poisoning presents some singular anomalies:—thus the insensibility may come on suddenly, but not immediately. Dr. Christison met with a case, where the individual fell suddenly into a deep stupor, some time after he had swallowed sixteen ounces of whiskey—there were none of the usual premonitory symptoms:—in another instance, a person will apparently recover from the first effects, and then suddenly become insensible, and die convulsed. In respect to *post-mortem appearances*;—the stomach has been found inflamed,—the mucous membrane being in one case of a bright red, and in another of a dark red brown colour. When death has taken place rapidly, there will be a strong odour of spirits in the contents of the stomach, but this may not be perceived if some time has elapsed before the inspection is made. The brain is found congested, and, in some instances, there is effusion of blood.

In a case, observed by Dr. Geoghegan, in which a pint of spirits had been taken, and proved fatal in eight hours, black extravasation was found on the mucous membrane; but no trace of alcohol could be detected in the contents of the stomach.—(Dub. Med. Press. 1, 293.

The quantity required to destroy life, cannot be very well determined, as it depends on the age and habits of the party. A boy, aged seven, has been killed by taking two wineglassfuls of brandy. Death may take place in a few minutes, or not until after the lapse of several days. The shortest fatal case which I have found reported, was that of a man who died in half an hour after swallowing a bottle of gin for a wager. This occurred in London in 1839: in a quarter of an hour after taking the gin he appeared intoxicated;—he soon became insensible, and died in half an hour, although a large quantity of the spirit had been removed by the stomach pump.

The following case occurred in 1840. A boy aged seven, swallowed about three ounces of brandy:—shortly afterwards he was observed to stagger,—he was sent to bed and vomited violently. In about four hours, he got up and sat by the fire; his head, face and neck were very red, and he was in a profuse perspiration. Half an hour afterwards he was found perfectly insensible, strongly convulsed, and the skin cold. He died in about thirty hours.

In April 1839, a case of poisoning by gin was communicated by Dr. Chowne to the Westminster Medical Society. A boy, aged eight, was found insensible about half an hour after he had swallowed gin. The quantity taken was supposed to have been half a pint. The liquid drawn from the stomach seven hours afterwards, had no odour of gin:—nor was the odour perceptible in the breath. He was insensible and motionless, the limbs relaxed and powerless, the face pale and the surface cold. The pulse was quick, small and feeble. He died without rallying or recovering his consciousness, sixty-seven hours after taking the poison. On inspection, there were no well-marked appearances found in the body,—the brain was healthy:—there was slight effusion of serous liquid, and the veins of the pia mater were distended. The stomach was pale and free from any mark of inflammation.

A singular case occurred at Barnes, in 1833, in which a young lady swallowed as a restorative, a draught of Eau de Cologne. Some hours after she fell into a state of stupor and died. No inspection was made.

The ordinary duration of fatal cases of poisoning by alcohol, is said to be from twelve to eighteen hours; but this can only be regarded as an approximative statement, since there are not many accurate reports of cases of this description, and among these there is considerable variation both as to the time of death, and the quantity of spirit taken.

Of the effects of drunkenness, and of delirium tremens, nothing need here be said. These conditions have an important bearing on questions relative to life-insurance and criminal responsibility: they will therefore be considered hereafter.

TREATMENT.—The contents of the stomach should be withdrawn by the pump as speedily as possible. Death may take place even where the stomach has been thoroughly evacuated, but this is the only chance of saving life.

ANALYSIS.—The different spirituous liquids may be recognized in the contents of the stomach by their peculiar odour; but only when death has taken place very rapidly. The contents should be distilled and treated with carbonate of potash or chloride of calcium, and again distilled. Alcohol may be obtained in the receiver, and is known; 1, by its odour and volatility; 2, by its inflammability; 3, by its power of dissolving camphor and resins.

Absorption does not appear to be absolutely necessary to the action of alcohol: but it would seem from the late researches of Dr. Percy, (see anté, p. 16.) that he has succeeded in detecting alcohol in the brain and liver, as well as in the blood, bile and urine. A spirituous odour is said to have been perceived in the brain, in cases where death had proceeded from natural causes. It would not be safe, when the evidence of the presence of alcohol in the body was material, for a medical jurist to rest upon any fact short of its its separation by distillation.

Instances have occurred in this metropolis, where alcoholic liquids have been made the vehicles for administering other poisons, such as opium or prussic acid. Persons have been thus rendered insensible; and in this state, have been robbed or murdered. Such cases may commonly be recognized by the fact that the symptoms when known are of far too severe a character to be referrible to the small quantity of alcoholic liquid taken.

Tincture of opium is most commonly administered in this way; and in such a case, there may be some difficulty in deciding whether the symptoms of intoxication be due to the drug or to the spirit.

According to Dr. Ure, the best London porter always contains opium as a fraudulent adulteration. He has found that, when diluted, it gives a brownish red colour with permuriate of iron, indicative of the presence of meconic acid, while tincture of hops gives only a greenish-coloured liquid. Having precipitated porter by acetate of lead, he found, on decomposing this precipitate by sulphuretted hydrogen gas, that he obtained clear evidence of the presence of meconic acid. He did not succeed in discovering morphia. (Med. Gaz. vi. 73.) These facts it may be proper for a medical jurist to bear in mind when called upon to investigate charges of administering opium in porter; but in repeating Dr. Ure's experiments, I have not obtained any results indicative of the presence of opium in this liquid. The precipitate obtained on adding a solution of acetate of lead to eight fluid ounces of porter, yielded not the slightest trace of meconic acid.

Other poisons are often mixed with spirituous liquids. I have known one instance in which oxalic acid was taken mixed with brandy: the person died under the usual symptoms of poisoning by oxalic acid. In December, 1841, a case occurred at Greenwich, where a man attempted to poison his wife by a strong dose of oxalic acid dissolved in gin. In these cases the kind of action is different, and the presence of the more active poison is indicated by the peculiarity of the symptoms.

WOUNDS.

CHAPTER XXIX.

WHAT IS A WOUND? IS THE WOUND DANGEROUS TO LIFE OR DID IT PRODUCE "GRIEVOUS BODILY HARM?"

When a person is the subject of a wound or external injury from the effects of which he ultimately recovers, a medical witness is often rigorously examined—with respect to the precise nature of the injury, and how far it involved a risk of life. The answers to these questions may have an important influence on the defence of a prisoner, when the crime is charged under particular forms of indictment.

What is a wound? It may, I think, be safely asserted, that we shall look in vain for any consistent definition of a wound, in works on medicine and surgery. A wound is, perhaps, most commonly defined to be, a "recent solution of continuity in the soft parts, suddenly occasioned by external causes." Yet those who adopt this view, do not regard as wounds, ruptures of the liver or spleen, burns by heated bodies, or simple dislocations and fractures, although all of these injuries are comprehended in the literal signification of the above definition.

The following definitions of a wound have been furnished to me by three eminent surgeons of this metropolis.

"A solution of continuity from violence of any naturally continuous parts."

"An external breach of continuity directly occasioned by violence."

"An injury to an organic texture by mechanical or other violence."

Owing to the unsettled meaning of the word wound, it has happened lately, on more than one occasion, that medical witnesses have differed in their evidence, and some difficulty has arisen in the prosecution of criminal charges. It has been asserted, that in order to constitute a wound, the skin should always be broken or injured; and this, as we shall see presently, is the interpretation commonly put upon the term by our judges. But those who have adopted this view, do not regard burns, produced either by heated metals or corrosive liquids, as wounds, although there seems to be no good reason why, under the above definition, they should be excluded.

Technical difficulties of this kind, which only lead to the embarrassment of witnesses and to the acquittal of prisoners, charged with serious offences, might be avoided if the medical witnesses of England were allowed to adopt the comprehensive definition sanctioned by the legal tribunals of certain states on the Continent, namely, that "a wound includes every description of personal injury, arising from whatever cause, applied externally." It may appear contrary to propriety to designate a contusion or fracture as a wound; but the common definitions will be found on examination to be equally inconsistent, and to be attended in legal medicine by evil results, inasmuch as they lead to acquittals, not upon the merits of the case, but upon the most trivial pretences. This could not happen if the above comprehensive signification were generally followed. It appears to me, that in a case of this kind, we should rather regard the wants of justice than the rules of surgery. If medico-legal cases fail from differences as to the meaning of scientific terms among surgical writers, it is time that some fixed rule should be adopted. While the science of surgery cannot possibly suffer by such an innovation, the administration of the law will be rendered much more efficient.

It cannot be denied, however, that an alteration of this kind, in the use of medical terms, must, in order to be attended with any good effects, receive the support of our legal authorities. This, probably, would not be long withheld, if good reasons for the change were afforded medical witnesses. The present rule appears to be that no injury constitutes a wound in law, *unless the continuity of the skin be broken*, so that in a case where blows were inflicted with a hammer or iron instrument sufficient to break the collar-bone, and violently bruise but not break the skin, it was held not to be a wounding within the statute. (Archbold.) A recent Act of Parliament (1 Vic. c. 85,) has in some measure provided for the punishment of persons guilty of inflicting such severe injuries, but still it has left the legal signification of the word wound, unsettled.

From several recent cases, it appears that an abrasion of the cuticle is not to be understood as a breaking of the continuity of the skin, the cutis or true skin must participate in the injury; and probably the cellular membrane beneath. A man was tried at the Central Criminal Court in August 1838, on a charge of cutting and wounding the prosecutor. The prisoner struck the prosecutor a severe blow on the temple with a heavy stone bottle, which was thereby broken to pieces. The prosecutor fell senseless, and it was a long time before he recovered from the effects of the violence. The medical witnesses in this case underwent a rigorous cross-examination by the prisoner's counsel, respecting the meaning of the word "wound." They said that there had been a separation of the cuticle or outer skin of the temples, although there was no absolute wound in the usual acceptation of the word. They further deposed that the prosecutor had lost the sight of his left eye, and the hearing of his left ear; and he was for a considerable time in a state of great danger from which he had scarcely recovered. The prisoner's counsel contended that the injuries were not such as to constitute cutting and wounding in law. The judge said, in order that a wound, in contemplation of law, should have been inflicted, it was necessary that the *whole skin*, and not the mere *cuticle*, should have been separated and divided; and as the evidence did not show distinctly that there was such a wound, those counts of the indictment could not be sustained. The prisoner was found guilty of an assault. Had he used a penknife, although he might have inflicted a much less degree of bodily injury, this man might, according to the above doctrine, have been found guilty under the highly penal statute of wounding. (See also the case of the Queen v. Mortlock, pôst.)

It would likewise appear that the continuity of the skin must be broken at the time of the infliction of the violence, and as a direct effect of it. Thus, if from a severe contusion, sloughing should take place, this would not constitute a wound, notwithstanding the very extensive destruction of the skin and soft parts, as an indirect result of the violence. So if a bone of the leg be broken by a blow, and the skin lacerated and a compound fracture produced by the assaulted party falling, it is doubtful whether this would be a wounding within the statute.

Again, if an assault be committed with a heated solid, such as a red-hot poker; although the whole skin might here be destroyed, it is extremely doubtful, whether such an injury would constitute a wound in law. In short, this subject, whether we regard it in a medical or legal aspect, is in a most unsettled state, and a conviction for the offence of criminal wounding, must depend in a great measure upon the care used in describing the injury in the indictment.

IS THE WOUND DANGEROUS TO LIFE, OR DID IT PRODUCE "GRIEVOUS BODILY HARM?" Answers to these questions are required of medical witnesses on the trials of persons charged with an attempt to murder or maim. Sometimes a written medical opinion, or a deposition may be demanded of a surgeon, by a magistrate in order to justify the detention of prisoners. The law has not defined the meaning of the words "dangerous to life," or to what description of wounds the term dangerous should be applied. This is a point which is left entirely to the professional knowledge of the witness. It is not always sufficient on these occasions, that the witness should make a naked declaration of the wound being dangerous to life; he must, if called upon, state to the court satisfactory reasons for this opinion; and these reasons are rigorously inquired into by the counsel for the defence. As a general principle, it would not be proper to consider those wounds dangerous to life, in which the danger is not imminent. A wound of a great blood-vessel, of any of the viscera, or a compound fracture with depression of the bones of the head, must all be regarded as bodily injuries dangerous to life; because in such cases, the danger is imminent. Unless timely assistance be rendered, these injuries will most probably prove fatal, and indeed they often destroy life in spite of the best surgical treatment. When, however, the danger is remote as in a puncture or laceration of the hand or foot which may be followed by tetanus, or in laceration of the scalp, which may be followed by erysipelas, or in penetrating wounds of the orbit, which may be attended by fatal inflammation of the brain or its membranes, the case is somewhat different. Such injuries, as are here described, are not directly dangerous to life, they are only liable to be attended with danger in certain cases; and therefore the medical opinion must be qualified. The law on these occasions, appears to contemplate the direct and not the future or possible occurrence of danger; if the last view were adopted, it is clear, that the most trivial lacerations and punctures might be pronounced dangerous to life; since tetanus or erysipelas proving fatal, has been an occasional consequence of very slight injuries.

A difference of opinion will sometimes exist as to whether a particular wound was or was not dangerous to life. Unanimity can only be expected, where the judgment and experience of the witnesses are equal. The rules for forming an opinion in these cases, will, perhaps, be best deduced from the results of the observations of the best surgical authorities in relation to injuries of different parts of the body. These will form a subject of examination hereafter.

If the witness admit, that the wound was not dangerous to life, then he may be required to state whether it was such as to have been capable of producing "*grievous bodily harm.*" The question is sometimes put, although the common practice is to leave this to be drawn by the jury, as an inference from the professional description of the injury. These words have a vague signification; but it would, perhaps, be difficult to substitute for them, others which would be less open to objection. They evidently refer to a minor description of offence, and are applied commonly to those injuries which, while they are not actually dangerous to life, may be attended with considerable personal inconvenience, or be in some way detrimental to the health ot the wounded party. It is always a question for the jury, whether the intent of the prisoner, in inflicting a wound, was or was not to produce grievous bodily harm; sometimes the nature or the situation of the wound, as well as the kind of weapon used, will at once explain the intent. So far the medical witness may assist the court, by giving a plain description of the injury, with the consequences by which it is usually attended. It may so happen, that the wound itself is not of a very serious nature, and yet the intention of the prisoner may have been to do grievous bodily harm to the wounded party; a fact which must then be made out by other evidence of a non-medical kind. This, of course, has no concern with the duties of a medical witness. (The Queen v. Maslin, Devizes Summer Assizes, 1838.)

The wound may be of such a nature as to cause death speedily, so that a practitioner may arrive only in time to see the wounded party die. In this case, the dying person may make a statement or declaration, as to the circumstances under which the wound was inflicted; he may also mention the names of the parties by whom he was assaulted. This dying declaration or statement, according to the circumstances under which it is made, may become of material importance in the prosecution of a party charged with homicide. It is therefore proper, that the practitioner should notice the exact condition of the dying person, whether at the time he makes the statement, he still retains any hope of recovery, either expressed in language, or implied by his conduct. It is not necessary that a man should declare that he believes himself to be dying, in order to render his statement admissible; this may be judged of by his actual bodily condition—by the symptoms under which he is labouring, and by the characters of the wound, when it is gradually but surely leading to a fatal result. No one is better qualified to form a judgment on these points than a medical practitioner. When it is made clear to the court that all hope of life was lost, the statement will be received as evidence against an accused person; for the law supposes, that in the act of dying all interest in this world is taken away; and that the near contemplation of death has the same powerful effect upon the mind as the solemn obligation of an oath. It is presumed that there can be no disposition on the part of a dying person, to wilfully misrepresent facts, or to state what is false. Much, therefore, often depends on the conduct of a medical practitioner under such circumstances; for the usual method of testing the truth of a statement by cross-examination is, of course, out of the question: it must, if admitted at all, be received as it was made.

No statement would be admissible when taken from a person, who had still some hope of recovery; yet a case may arise in which a practitioner might be in doubt upon this point. His duty then consists in taking the statement, and leaving the court to decide upon its admissibility from the facts observed and stated by him. A medical man should not render himself officious, in extracting information from a dying person under these circumstances. He should receive what is voluntarily uttered; and write the statement down, in the *identical* words, carefully avoiding his own interpretation of them, either immediately or on the earliest possible opportunity. On no account should leading questions be put;—and any question should be simply confined to the purpose of explaining what may appear ambiguous or contradictory in the declaration.

It is well known that when death takes place from violence, especially when this proceeds from hæmorrhage or a wound of the head, delirium is apt to supervene, or the intellect of the dying person becomes confused. Under these circumstances, great caution should be used in receiving a declaration, since it may lead to the implication of innocent parties. It is also proper to remark, that the identity of persons is at this time apt to be mistaken; and that it is in general a most injudicious proceeding to take a suspected party before one who is dying, in order that he may be identified. A fatal mistake of this kind was made some years since in London. A woman was maltreated by some men on Kennington Common:—she was taken to St. Thomas's Hospital; and while dying from the effects of the violence, a suspected party was brought before her, as one of the supposed assailants. She deposed that he was one of those who had assaulted her. The man was tried upon her declaration, respecting his identity,—found guilty, and executed; but a year after the execution, his innocence was satisfactorily established by the discovery of the real murderers.

These are the principal medico-legal questions, connected with wounds when the wounded person is seen while living. We will suppose, however, that the wounded person is found dead, and an examination of the body is required to be made. The most difficult part of the duty of a medical jurist now commences. Among the numerous questions which here present themselves, we will first proceed to inquire whether the wound was inflicted on the body before or after death.

CHAPTER XXX.

WHETHER THE WOUND WAS INFLICTED BEFORE OR AFTER DEATH?

In examining a wound on a dead body, it is necessary to observe its situation, extent, length, breadth, depth, and direction;—whether there be about it effused blood, either liquid or coagulated, and whether there be ecchymosis in the skin. It should also be ascertained, whether the surrounding parts be swollen,—adhesive matter or pus effused,—the edges of the wound gangrenous, or any foreign substances be present in it. The wound may be best examined by gently introducing into it a bougie, and carrying on the dissection around this instrument, avoiding as much as possible any interference with the external appearances. The preservation of the external form will allow of a comparison being made at any future time, between the edges of a wound, and a weapon found on a suspected person. Of all these points, notes should be taken, either on the spot or immediately afterwards, in the way recommended in a former chapter. (See antè, p. 29.)

In the dissection, every muscle, vessel, or nerve involved in the injury should be traced and described. This will enable the witness to answer many subordinate questions that may unexpectedly arise during the inquiry. One other point should be especially attended to. A medical practitioner has frequently contented himself by confining his dissection to the injured part, thinking that on the trial of the accused party, the questions of counsel would be limited to the situation and extent of the wound only: but this is a serious mistake. If the cause of death from a local injury, be at all obscure, on no account should the inspection be abandoned until every organ and cavity of the body have been closely examined: since it may be affirmed that a natural cause of death might have existed in that organ or cavity, which the medical witness neglected to examine. It rests with the practitioner to disprove the probability thus urged by counsel, but he is now destitute of facts to reason from: legal ingenuity will triumph, the witness will be discomfited, and the prisoner, of whose guilt there may be, morally speaking, but little doubt, will have the benefit of his inattention, and be acquitted by the jury. The following case, which occurred a few years since on the Home circuit, will serve as an example of the necessity for making a close inspection of the body, in death from wounds.

Three men were tried on a charge of manslaughter: the evidence brought against them was as follows. The prisoners and the deceased had been drinking together at a public house, when a quarrel arose, which ended in a battle between the deceased and one of the prisoners. The other two acted as seconds. The fight had continued for some time, when the deceased was knocked down by a severe blow on the head and did not speak afterwards. A surgeon was sent for, but before his arrival the deceased had expired. On the trial, this witness stated, that he found a considerable bruise behind the ear in the region of the mastoid process, accompanied by an extravasation of blood. On being cross-examined, he admitted that he did not open the cranium, the coroner having told him that it was unnecessary. He ascribed the death of the deceased to a pressure of blood on the brain, which, in his opinion, might have become extravasated from a blow or fall, or from extraordinary excitement. The deceased was of an apoplectic diathesis.

The learned judge observed to the jury in summing up, that the medical evidence was not sufficient to determine whether the deceased had died from the violence employed by the prisoner, or from natural causes. An acquittal instantly followed! An ingenious cross-examination was made in the well-known case of Greenacre, tried in 1837 on a charge of murder by mutilation. The only part of the body of the deceased, not examined by the medical witnesses, was the spinal canal. They admitted that an injury to the spinal marrow might produce speedy death; but a blow capable of producing such injury, would be likely to leave marks of violence externally: and none existed in the region of the spine in this case. The strong corroborative evidence of the real cause of death, rendered this mode of explaining it, in the highest degree improbable.

It is scarcely necessary to adduce other cases to establish the importance of the principle of duty here advocated. The simple consequence of rigorously adhering to it, will be to give a little more trouble to the practitioner, which may occasionally prove unnecessary,—while, on the other hand, the consequences of neglecting it may be to risk his professional reputation and expose him to severe reproof from the court.

Characters of a wound inflicted during life.—If we find about the wound, marks of gangrene, the effusion of adhesive or purulent matter, or if the edges be swollen and enlarged, and cicatrization have commenced, it is not only certain that it must have been inflicted before death, but that the individual must have lived some time after its infliction. Marks of this description will not, however, be commonly found, when death has taken place within ten or twelve hours after the receipt of the injury. A wound which proves fatal within this period of time, will present throughout much the same characters :—supposing it to have been *incised,* there will be traces of more or less hæmorrhage, having chiefly an arterial character, and the blood coagulating as it falls on surrounding bodies :—the edges of the wound are everted, and the cellular tissue around is deeply reddened by effused blood. Coagula are found adhering to the wound, provided it has not been interfered with. The principal characters of a wound inflicted during life are then the following :—1. Eversion of the edges, owing to vital elasticity of the skin. 2. Abundant hæmorrhage, often of an arterial character, with general sanguineous infiltration of the surrounding parts. 3. The presence of coagula.

CHARACTERS OF A WOUND MADE AFTER DEATH.—If the wound on the dead body be not made until twelve or fourteen hours have elapsed from the time of death, it cannot be easily mistaken for one produced during life. Either no blood is effused, or it is of a venous character, proceeding from some divided vein—the blood is commonly liquid, not coagulating as it falls on surrounding bodies, like that poured out of a vital wound. The edges are soft, yielding and destitute of elasticity, they are therefore in close approximation. The cellular tissue around, is either not infiltrated with blood, or only to a very partial extent. There are no coagula within the wound. In experimenting upon amputated limbs, I have found these same characters possessed by a post-mortem wound, even where it had been produced not later than two or three hours after death : although they are best seen when the wound is not made until after the body has lost all its animal heat. In wounds on the dead subject divided arteries have no marks of blood about them : in the living subject the fatal hæmorrhage commonly proceeds from these vessels : hence, in a wound on the living, it will be found that the surrounding vessels are empty. The chief characters of a post-mortem wound, are therefore,—1. Absence of copious hæmorrhage. 2. If there be hæmorrhage, it is exclusively venous. 3. The edges of the wound are close, not everted. 4. There is no sanguineous infiltration in the cellular tissue. 5. There is an absence of coagula.

But it may happen, that the wound was inflicted soon after the breath had left the body, and while it was yet warm. The distinction between a wound then made, and one made during life, is not so well marked, as in wounds inflicted at a later period after death. Observations of this kind, on the human subject, must of course be purely accidental, and there are many obstacles to the performance of experiments on the recently dead. I, therefore, selected limbs, immediately after amputation ; and there is no reason to suppose, that the results obtained in these cases, would differ very widely from those derived from experiments made on the entire body.

In the first experiment an incised wound about three inches in length was made in the upper part of the calf of the leg *two minutes* after its separation from the body, by which the gastrocnemii muscles and the fascia covering the deep-seated layer of the leg were divided. At the moment that the wound was made, the skin retracted considerably, causing a protrusion of the adipose substance beneath: the quantity of blood which escaped was small, the cellular membrane by its sudden protrusion forwards, seeming mechanically to prevent its exit. The wound was examined after the lapse of twenty-four hours,—the edges were red, bloody, and everted,—the skin was not in the least degree tumefied but merely somewhat flaccid. On separating the edges, a small quantity of fluid blood escaped, but no coagula were seen adhering to the muscles. At the bottom of the wound, however, and in close contact with the fascia, was a small quantity of coagulated blood; but the coagula were so loose, as readily to break down under the finger.

In the second experiment, an incision of similar extent was made on the outer side of the leg, penetrating through the peronei and into the flexor longus pollicis of the deep-seated layer of muscles, *ten minutes* after the separation of the member from the body. In this case the skin appeared already to have lost its elasticity, for the edges of the wound became but very slightly everted; scarcely any blood escaped from it. On examining the leg twenty-four hours afterwards, the edges of the incision were pale and perfectly collapsed, presenting none of the characters of a wound inflicted during life. Still, at the bottom of the wound, and enclosed by the divided muscular fibres, there were some coagula of blood, but these were certainly fewer than in the former experiment. A portion of liquid blood had evidently escaped owing to the leg having been moved.

Other experiments were performed at a still later period after the removal of the limbs, and it was found that in proportion to the length of time suffered to elapse before the production of the wound, so were the appearances less distinctly marked, that is to say, the less likely were they to be confounded with similar injuries inflicted upon the living body. When the incised wound was not made until *two or three hours* after the removal of the limb, although a small quantity of liquid blood was effused, no coagula were found.

It is necessary to remember that when an incised wound is the cause of death, the person either dies immediately, in which case there is a most abundant hæmorrhage from the wounded organ or some large vessel,—or he dies after some time, in which case, as the wound continues to bleed during the time that he survives, the longer he lives the more copious will be the effusion of blood. In a wound inflicted soon after death, and while the body is warm, nothing of this kind is observed. Unless the weapon injure one of the large veins, the hæmorrhage is always slight, so that the quantity of blood lost may assist us in determining whether the wound was made during life or after death. When the body has been moved, and all marks of blood effaced by washing, rules of this kind cannot serve a medical witness:—the time at which the wound was actually inflicted, must then be deduced from other circumstances.

In the case of Greenacre, who was tried in 1837, for the murder and mutilation of a female, this formed a material part of the medical evidence. The head of the deceased had been severed from the body, and the question was, whether this severance had taken place during life or after death. The prisoner alleged in his defence, that it was after death; but the medical evidence went to establish that the head must have been cut off, while the woman was living, but probably after she had been rendered insensible by a blow on that part, the marks of which were plainly visible. This medical opinion was founded on two circumstances. The muscles of the neck were retracted, and the head was completely drained of its blood, showing that a most copious and abundant flow must have ensued at the time of the separation; and therefore indicating that the circulation was probably going on at that time. On cutting off a head after death, a small quantity of blood may escape from the jugular veins; but this soon ceases, and the quantity lost is insufficient to affect materially the contents of the cerebral vessels.

The chief medical witness, Mr Girdwood, expressed himself with very proper caution, by stating, in answer to a question from the judge, that all the wounds in the neck must have been inflicted either during life for very shortly after death, while the body still preserved its warmth. The circumstantial evidence tended to show, that the deceased was first stunned, and that her head was cut off while she was in a state of stupor.

In any future case, when the vital or post-mortem origin of a wound is doubtful, it will be proper to adopt the same cautious mode of expressing a medical opinion; since there are no decisive characters by which wounds of the kind referred to, can be distinguished; and a medical witness is as likely to be wrong as right in selecting either hypothesis. It is a considerable step in evidence, when we are able to assert, that a particular wound found on a dead body, must have been inflicted either during life or *immediately* after death; for it can scarcely be supposed, that in any case, calling for criminal investigation, any one but a murderer would think of inflicting such a wound upon a body immediately after death, which would assuredly have produced fatal effects had the same person received it while living. So soon as such an opinion can be safely expressed by a witness, circumstantial evidence will often make up for that which may be medically speaking a matter of uncertainty.

WOUNDS OR INJURIES UNATTENDED BY HÆMORRHAGE.—The copious effusion of blood has been set down as a well-marked character of a severe wound received during life; but this observation applies chiefly to incised wounds,—cuts and stabs. Lacerated and contused wounds of a very severe kind, are not often accompanied by much hæmorrhage, even when a large blood-vessel happens to be implicated. It is well known, that a whole member has been torn from the trunk, and that little blood has been lost; but in such cases, coagula are commonly found adhering to the separated parts,—a character which indicates either a vital or a very recent post-mortem origin. Contusions and contused wounds are commonly accompanied by a discolouration of the surrounding skin, to which the term ecchymosis is applied.

ECCHYMOSIS.—The subject of ecchymosis is of considerable importance in legal medicine, since it has often given rise to numerous difficulties and complicated questions. It consists essentially in the extravasation or effusion of blood from ruptured vessels into the surrounding cellular texture. An ecchymosis is in general superficial, affecting only the layers of the skin and showing itself externally, either immediately or in the course of a short time in the form of a deep blue or livid red patch. According to Dr. Chowne, the former colour is met with in the ecchymosis slowly produced; while that which is the immediate result of violence, is red or livid red. In some instances, the ecchymosis is deep-seated,—the blood being effused among the muscles and beneath the fasciæ; its extent cannot then be so readily determined by the external discolouration, for this is commonly slight, and it appears only after the lapse of some hours, or even two or three days.

Sometimes the ecchymosis shows itself not over the immediate seat of injury or around it, but at some distance from it. This is a matter of some importance to the medical jurist, since he might be led to suppose that the violence had been applied to the discoloured portion of skin, whereas the extravasation may have been produced by what some have called contre-coup. Dr. Chowne met with an instance where a young man received a severe bruise on the inner side of the ankle. In two days, ecchymosis appeared around the outer ankle. The term contre-coup is, however, inappropriate; since the blood will diffuse itself where it meets with the least resistance, and the layers of the skin in the part struck may become condensed by the blow, so that the blood is diffused in the cellular membrane of the adjoining parts. Mr. Syme, of Edinburgh, met with a case where a compound fracture of the tibia, about one-third down, was produced by the wheel of a carriage passing over the leg of a woman. There was no ecchymosis around the seat of injury; but after some days the skin of the knee and lower part of the thigh, became ecchymosed. (Ed. Med. and Surg. Jour. Oct. 1836.) It is proper to mention, that ecchymosis may sometimes proceed from causes irrespective of the direct application of violence to the skin. Strong muscular exertion,—the act of vomiting and many other conditions, may give rise to a rupture of the minute vessels, and to an effusion of blood in parts which have been stretched or compressed. I have known it to have been produced to a great extent around the knee, from the stretching of the ligamentum patellæ, in an individual, who was trying to save himself from suddenly falling forwards with his knee bent under him. Such cases are commonly recognised by there being no mark of mechanical injury about the part:—the skin is smooth and unabraded.

The changes which sometimes take place in the colour of an ecchymosed spot, are worthy of the attention of a medical jurist, since they will serve to aid him in giving an opinion as to the probable time at which a contusion has been inflicted. After a certain period, commonly in eighteen or twenty-four hours, the blue or livid margin of the spot is observed to become lighter; it acquires a violet tint, and before its final disappearance it passes successively through shades of a green, yellow and lemon colour. During this time, the spot becomes much increased in extent, but the central portion of the ecchymosis is always darker than the circumference. These changes have been referred by Chaussier and others to the gradual dilution of the extravasated blood by the serous fluid of the cellular membrane, and its slow and uniform dispersion throughout the cells. The colour is finally entirely removed by the absorption of the extravasated blood. The extent and situation of the ecchymosis, the degree of violence by which it has been produced, as well as the age and state of health of the person, are so many circumstances which may influence the progress of these phenomena. Thus an ecchymosis is longer in disappearing in the old than in the young. Mr. Watson, of Edinburgh, found extravasated blood in an ecchymosis in an old person, five weeks after the receipt of the injury. Where the cellular membrane is dense, the ecchymosis, cæteris paribus, is not so rapidly formed; nor, when formed, do the above changes so speedily take place in it, as where the blood is effused into a loose portion of the membrane, like that surrounding the eye or existing in the scrotum. In some instances an ecchymosis has been observed to disappear without undergoing these changes of colour at its margin. On examining an ecchymosed portion of skin which has suffered from a severe contusion, we find that the discolouration affects more or less the whole substance of the cutis as well as the cellular membrane beneath: this, it is necessary to remember in forming our diagnosis.

It not unfrequently happens that the ecchymosis produced by a contusion, will assume a form indicative of the means by which the violence was offered. In hanging, the impression caused by the cord on the neck is sometimes ecchymosed and indicates its course with precision;—so also in strangulation, where the fingers have been violently applied to the fore part of the neck, the indentations produced may serve to point out the manner in which life was destroyed. A case is mentioned by Starkie, which shows that the form of an ecchymosis may occasionally furnish very strong presumptive evidence against an accused party. In an attempt at murder, the prosecutor, in his own defence, struck the assassin violently in the face with the key of the house-door, this being the only weapon he had near at hand. The ecchymosis which followed this contusion, corresponded in the impression produced on the face, to the wards of the key, and it was chiefly through this very singular and unexpected source of evidence, that the assassin was afterwards identified and brought to trial. (Law of Evidence, vol. i. Art. Circ. Ev.)

For our knowledge of the effects of contusions on the recently dead subject we are chiefly indebted to Dr. Christison. This gentleman found that blows inflicted two hours after death, will give rise to appearances on the skin similar to those resulting from blows inflicted recently before death. The livid discolouration thus produced, generally arose from an effusion of the thinnest possible layer of the fluid part of the blood on the outer surface of the true skin, but sometimes also from an effusion of blood into a perceptible stratum of the true skin itself. He likewise found that dark fluid blood might even be effused into the subcutaneous cellular tissue in the seat of the discolourations, so as to blacken or redden the membranous partitions of the adipose cells, but this last effusion was never extensive. From this then, it follows, that by trusting to external appearance only, contusions made after death may be confounded with those which have been produced by violence immediately before death.

If the contusion has been caused some time before death, there will be swelling of the part and probably also certain changes of colour in the ecchymosed patch, in either of which cases there will commonly be no difficulty in forming a diagnosis. Although ecchymosis or an appearance analogous to it may be produced after death, the changes in colour are only then met with under very peculiar circumstances, to be presently mentioned. If the blood found beneath the ecchymosed spot is in the state of coagulum, this affords a remote presumption of its having been effused during life, although, in fact, it only proves that the effusion must have taken place before death, or very soon after it; and the experiments related, in speaking of incised wounds, show that the blood effused from a wound ten minutes after death may be found in a coagulated state. Again, the circumstance of the blood effused under a contused wound being liquid, is not to be considered as a proof that the effusion did not take place during life; for sometimes the effused blood will not coagulate after death. Blood effused into the spinal canal during life is often fluid: and it is well known that the blood may be found coagulated in some parts of the body, while it remains uncoagulated in others. Those contusions produced during life, in which the effused blood remains liquid, may be recognized by the extent of the effusion. If, under the ecchymosed part, we find a large quantity of liquid blood and the seat of injury is so situated that the blood could not have become infiltrated into it, and at the same time there is no ruptured vein from which it might flow, we may confidently pronounce that the effusion must have preceded death. In a dead body, a contusion would cause but little extravasation, unless a vein of very apparent size were torn through. The sign which is most satisfactory as a criterion, in the opinion of Dr. Christison, is the following. In a contusion inflicted during life, the ecchymosed portion of cutis is generally dark and much discoloured by the infiltration of blood throughout its whole thickness,—the skin at the same time is increased in firmness and tenacity. This is not, however, a uniform consequence of a contusion during life, for a blow may cause extensive extravasation below the skin without affecting the cutis in the manner stated. The state of the skin here described, cannot, however, be produced by a contusion on a dead subject; but it is questionable whether it might not be produced if the contusion were inflicted a few minutes after death. As it is, its value is somewhat circumscribed,—it is not always produced on the living,—it might be possibly produced on the recently dead, so that where it does not exist, we must look for other diagnostic marks, and where it does exist, we ought to satisfy ourselves that the contusion was not inflicted recently after death.

The period at which such injuries cease to resemble each other, has not been fixed with any degree of precision; but, as in the case of incised wounds, it would seem that there is little danger of confounding them when the contusion has not been inflicted on the dead subject, until after the disappearance of animal heat and the commencement of cadaverous rigidity. Dr. Christison remarks, that sometimes the appearance of contusions can hardly be produced on the dead body two hours after death, at others they may be slightly caused after three hours and a quarter, but this period is near the extreme limit. Whenever the warmth of the body and the laxity of the muscles are not considerable at the time the blow is inflicted, the appearance of vital contusions cannot be very clearly produced. It is probably, therefore, only on the trunk that, even in the most favourable state of the body, namely, when the blood remains altogether liquid, any material mark resembling what may be termed a vital contusion can be produced so late as two hours after death. (Ed. Med. and S. Journ. No. xcix. p. 247 et seq.)

Notwithstanding these very satisfactory results, it will be seen, that from the moment of death until after the lapse of two hours, contusions may be followed by appearances on the dead body almost identical with those observed on the living. The earliest period after death in which an experiment was tried on the human subject, was one hour and three-quarters: in this case the similarity was so strong that we may infer, if the experiments had been performed within half an hour, or even one hour after dissolution, a clear diagnosis would have been scarcely possible.

There are certain conditions of the body in which ecchymosed marks are found on the skin, and which a witness must be careful not to confound with the ecchymosis arising from violence. First, with regard to the *living* body—in very aged persons, it is not unusual to find the legs and feet covered with livid patches, sometimes of considerable uniformity of colour, at others very much mottled. These discolourations, which, after death, might be mistaken for ecchymosis from violence, are owing to the languor of the capillary circulation in such subjects: the blood with difficulty finds its way through the venous capillaries, and the marks are commonly observed on this part of the body, because it is far removed from the centre of circulation, and the blood has to rise contrary to the law of gravity. This is the condition which has been denominated by Andral, asthenic hyperemia. (Andral Anat. Pathol. t. i. p. 40.) Similar discolourations are sometimes met with on the bodies of those who have died from scurvy, typhus and other adynamic diseases. In persons severely affected with scurvy, it is well known that the slightest pressure on any part of the skin will suffice to produce a spot resembling ecchymosis, and arising like it from a rupture of minute cutaneous vessels; but the extravasation of blood, which causes the discolouration, is commonly confined to the superficial layers of the true skin. These spots, under certain states of the system, occur spontaneously, and often cover the body to a great extent; when small, they take the name of petechiæ, but when extensive, in which case they bear a very close resemblance to the ecchymosis of violence, they constitute the chief pathognomonic character of the disease termed purpura. To all these effusions of blood in the living body the term *Sugillation* (from *sugillatio*—a black mark) has been applied. Some medical jurists have attempted to draw a distinction between ecchymosis and sugillation,—thus it is said;—ecchymosis proceeds from external, sugillation from internal causes,—ecchymosis is confined to the marks which occur in the living body, sugillation to those which occur in the dead,—in ecchymosis the vessels are ruptured, in sugillation there is mere congestion;—again, some have considered that ecchymosis and sugillation might take place both in the living and in the dead. From this statement it appears impossible to give a consistent definition of the meaning of either of these terms; but it is altogether unnecessary to make the attempt, for the error, after all, consists in the introduction of a superfluity of words to express a simple condition of the body, depending on different causes. Why an ecchymosis should not also be called a sugillation, it is difficult to say; for so far as we are bound by a comparison of the various definitions above given, with the usual applications of these words, the terms are equally appropriate. I would advise a medical jurist to avoid the use of the term sugillation, if by employing it, he considers that he is speaking of a condition essentially different from ecchymosis. The most important point to attend to, is to distinguish these ecchymoses in the living body arising from infirmity or disease, from those which have their origin in violence. In regard to the spots on the legs of old persons, the appearance of the subject, and their general extent, enveloping, as they often do, the whole circumference of the leg, must suffice to establish a correct diagnosis. In distinguishing the spots of purpura a difficulty may sometimes exist,—but here also the appearance of the subject, the general diffusion of the spots over the whole of the body, and their existence on the mucous membrane of the fauces and alimentary canal, cannot fail to point out that they originate from some other cause than violence. In the living these spots have been observed to undergo the same changes of colour as the true ecchymosis of violence. It has been alleged on the authority of Zacchias, one of the early writers on Medical Jurisprudence, that a diagnosis is obtained in these cases after death by a dissection of the part. According to this authority, in what is termed sugillation, i. e. the ecchymosis of disease, the blood is stated to be fluid, while in the ecchymosis of violence it is described as being in a thick and concrete state. In the remarks already made respecting contusions, facts have been mentioned which show that such a mode of distinction is inadmissible: neither the state of the blood nor its situation will alone suffice to determine the question. Although it has been usual to describe the ecchymosis of disease as being due to a superficial extravasation on the true skin, yet certain cases recorded by pathologists, prove that in purpura the discolouration may occasionally extend through the whole substance of the integuments to the adipose tissue beneath.

Secondly, With regard to the *dead* body. Ecchymosis may present itself in various forms on the skin of a dead subject. The first form, when it occurs, is almost an immediate consequence of death, but it is not fully developed until the body has cooled. It is commonly called lividity or cadaverous ecchymosis. It presents itself in diffused patches of very great extent, sometimes covering the whole of the fore part of the chest and abdomen, at other times the lateral regions of the back. The upper or lower extremities either on their internal or external surfaces, or on their whole circumference, are often thus completely ecchymosed. The colour is sometimes purple, at others livid, and often mottled in interspaces, but it is commonly well defined in its extent by the whiteness of the surrounding skin. This form of ecchymosis is almost invariably seen on the bodies of those who die suddenly or by a violent death, as in individuals who perish from apoplexy or who are hanged or suffocated. When the skin is divided, the colour is found to be confined to the upper surface of the cutis, and never to extend through it. This discolouration is ascribed to the congestion which takes place in the capillary system at the moment of death in subjects which are full of blood. It is rarely seen in the bodies of those who have died from profuse hemorrhage—the skin is in these cases commonly pallid. The circumstances under which it occurs, and the characters above described, distinguish it from the ecchymosis of violence. Its existence on the dead body, must be regarded as a sign of the vigour and activity of the circulation at the moment of death, and generally as a mark of death having taken place suddenly. It might seem improper to call this, which has been described as a mere capillary congestion—'*ecchymosis*'—this word signifying effusion; but the term *sugillation* has been so vaguely employed by different writers, that I think the former preferable to the latter, in spite of the apparent inconsistency of its application to every variety of cutaneous discolouration.

Sometimes, instead of seeing this cadaverous ecchymosis diffused in large patches over the skin, it will be disposed in stripes which traverse and intersect each other in all directions, and often cover the whole of the body. These marks, which vary from a scarlet to a dark red or livid hue, have been supposed to resemble those produced on the skin in the act of scourging or flagellation. On this account they have been called by some writers *vibices*. Sometimes the body is completely covered with them,—they are often of considerable length, and pass in a very symmetrical but occasionally tortuous course: they are chiefly observed about the sides, the upper part of the shoulders, and back. In meeting with this appearance for the first time on a subject, an individual, unacquainted with its nature, might look upon it as a strong proof of violent treatment during life, especially in a case of suspected violence; but the practitioner will distinguish it readily, by the uninjured state of the cuticle and the superficial nature of the discolouration, from those marks of violence which it is considered to resemble. In general it appears to be produced by the wrapping of a body in a sheet or other covering soon after death, and allowing it to cool while thus wrapped up: even if a subject be allowed to cool merely with the clothes covering it, these peculiar marks will often be seen. In many cases they exist only on the back, and here they are to be ascribed to the pressure produced by the irregularities or folds in the sheet on which the body has been lying. The blood, it is to be observed, is always congested in or near those parts of the skin which are exposed to the least pressure.

A few years since I saw a well-marked case of vibices, in which the suspicion was so strong that violence had been used to the deceased, that a coroner's inquest took place. The fore part of the body was covered with the stripes, which were of a red and livid colour: they seemed to correspond exactly to the folds of a sheet drawn tightly across the chest, and I subsequently ascertained that the body of the deceased had been treated in this way after death. The blood was superficially diffused, and the cuticle sound. The circumstance above mentioned at once satisfactorily explained the cause of the appearance. These vibices, like the cadaverous ecchymosis already described, are commonly seen in plethoric subjects; they also indicate great vigour of circulation at the moment of death.

But lividity sometimes presents itself in a more deceptive form than in either of the instances just mentioned. For the particulars of the following interesting case, I am indebted to Mr. Tuckett:—

A man, aged thirty-three, died suddenly from disease of the heart. Just before death he had been auscultated, and no marks whatever existed upon his skin. Eighteen hours after death, the body was examined, and the skin was then found to be covered in different parts with patches of ecchymosis, varying in size from small spots to others of several inches in diameter. These patches were evidently due to simple lividity, although they closely simulated marks of violence produced during life. Thus those parts of the back and limbs, which were not compressed by the surface on which the body of the deceased was lying, were the only parts ecchymosed. On cutting into these patches, the layers of the cutis as well as the cellular tissue beneath, were throughout reddened by congested blood. There was no decided extravasation, but small rounded semicoagulated masses oozed out from the cells on slight pressure. There was another extraordinary, and so far as I know, a perfectly unexampled circumstance, in which these patches of lividity resembled the ecchymosis of violence, produced during life. Around many of them, there was a wide border or ring of straw colour with various shades of green, precisely similar to those witnessed in the disappearance of an ecchymosis from the living subject. By all medical jurists, it has been hitherto laid down as a positive axiom, that these rings of colour, when not depending on putrefaction, are peculiar to the ecchymosis of the living body, and are never seen in the ecchymosis taking place spontaneously after death. The occurrence of this case, shows with what caution general rules should be framed for medico-legal practice. Had the body of this person been found lying dead exposed on a high road, and it was proved that another man had been quarrelling with him, it is easy to imagine, that a very unfavourable medical opinion might have been expressed against the party accused of the violence. This kind of ecchymosis could only have been distinguished from that of violence during life, by the unruffled state of the skin, and the very slight extravasation of blood compared with the extent of the ecchymosed surface. It is worthy of note also, that the principal seat of the ecchymosis was in those parts which were recumbent or depending. The formation of the coloured zones around some of the patches of lividity, was fully explained by the fact of the man having laboured under anasarca. The serum effused in the cells here acted upon and diluted the blood as it became extravasated, and diffused it around, much in the same way, as the serous exhalation of the cellular membrane acts on the blood effused in the living body. A wax model of this remarkable appearance is preserved in the Museum of Guy's Hospital, and is well worthy of inspection.

Another form of ecchymosis observed in the dead body, is that which occurs some time after death. This appears to proceed from an infiltration of blood into the depending parts of the body and to be a result of incipient putrefaction. Those engaged in post-mortem inspections, are well aware that the skin of the back, especially that covering the loins and buttocks, often presents irregular discolourations resembling ecchymosis. The skin of the occiput, is a well-known seat of this form of ecchymosis. On cutting into the skin of any of these parts, the whole of the cutis is found to be more or less discoloured, and the adipose tissue is filled with a sanguineous serum which readily escapes. In proportion as putrefaction advances, the discolouration becomes greater, passing from a dark red to a green colour. The general characters of this species of ecchymosis, are so well marked, that it cannot easily be confounded with the ecchymosis of violence. The parts of the body in which it is known to occur, as well as the state of the body, distinguish it from all other forms described. This variety of ecchymosis is also termed sugillation by some medical jurists.

IS ECCHYMOSIS A NECESSARY AND CONSTANT RESULT OF ANY VIOLENCE PRODUCING CONTUSION?—This is a most important medico-legal question, and one which has often created great difficulty to medical witnesses. It has been repeatedly asserted in courts of law, that no severe blow could have been inflicted on a deceased person in consequence of the absence of ecchymosis from the part struck; but we shall see, that this assertion is entirely opposed to well-ascertained facts. However true the general principle may be, that severe contusions are commonly followed by ecchymosis, it is open to numerous exceptions; and unless these be known to the practitioner, his evidence may mislead the court. The presence of ecchymosis, is commonly presumptive evidence of the infliction of violence; but its absence does not negative this presumption.

It was long since remarked by Portal, that the spleen had been found ruptured from blows or falls, without any ecchymosis or abrasion of the skin, appearing in the region struck. The same has been more recently remarked in respect to ruptures of the stomach, intestines and urinary bladder, from violence directly applied to the abdomen. Portal supposed that the mechanical impulse was simply transferred, through the supple parietes of the abdominal cavity to the viscera behind, as in the striking of a bladder filled with water. Whether this be the true explanation or not, it is quite certain that the small vessels of the skin often escape rupture from the shock, so that their contents are not extravasated.

A case is reported by Henke, from which it appears, that a labouring man died some hours after fighting with another. On inspection, the peritoneum was extensively inflamed owing to an extravasation of the contents of the jejunum, which was found ruptured to a considerable extent. There was no ecchymosis or mark on the skin externally, and the medical inspectors were inclined to affirm, contrary in this case to direct evidence, that no blow could have been struck; but others were appealed to, who at once admitted that the laceration of the intestine might have been caused by a blow, even although there was no appearance of violence externally.

Mr. Watson states, that a girl aged nine, received a smart blow upon the abdomen from a stone. She immediately complained of great pain; collapse ensued, and she died in twenty-one hours. On inspection there was no mark of injury externally. The ileum was found ruptured, its contents extravasated; and the peritoneum extensively inflamed (On Homicide, 187.) Dr. Williamson, of Leith, met with a case where a man received a kick on the abdomen from a horse. He died in thirty hours from peritonitis. The ileum was found to have been completely torn across in its lower third. There was not the slightest trace of ecchymosis externally, and this fact is the more remarkable, since the blow was here struck by a somewhat angular or pointed body—the hoof of the horse. (Med. Gaz. May, 1840.) A girl was accidentally struck on the back by a log of timber, and she died in a few minutes afterwards. On inspection the right lobe of the liver was found torn through, and the stomach greatly lacerated. Notwithstanding the production of these severe injuries, there was no trace of ecchymosis, or any other mark of violence externally. (Henke Zeitschrift der S. A. 1837, ii. 356.)

The same facts have been observed in injuries of the chest, where, from the bony nature of the parietes, we might commonly expect to find ecchymosis or abrasion to some extent.

Dr. Geoghegan, of Dublin, has described a case, where a girl was struck by the seat of a jaunting car, the wheel of which was supposed to have passed over her. She was killed on the spot. The chest was carefully examined,—the skin, muscles, and thoracic parietes afforded no indications of violence; but it was found that there was considerable effusion of blood, and the heart was ruptured throughout its entire length. (Dub. Med. Press, ii. 271.) In an accident, which occurred in October, 1841, a girl was run over by a cab:—she died in two hours. There was no ecchymosis, or mark of injury externally; but the right lung was ruptured, and blood was extravasated in the chest. In March, 1840, a man was brought into St. Thomas's Hospital, who had been run over by a waggon. He survived thirty-six hours. On examination all the ribs on the right side of the chest were found broken. The right pleura was filled with blood and the lung collapsed. Part of the right kidney was lying amidst the blood, having passed through a fissure produced in the fleshy part of the diaphragm by one of the broken ribs. In this case of very severe injury, there was no external mark of bruise or ecchymosis:—the skin was uninjured.

That the skin is not always injured in these severe cases of violence, appears to be due to its great elasticity; but it is difficult to explain, how the vessels should escape rupture by a crushing force, where there is a bone beneath; nevertheless such is the fact, and it is with the fact more than with the explanation, that a medical jurist has to deal.

It has been supposed necessary, that an individual should survive the effects of violence for some hours, in order that ecchymosis should be observed in the part struck. Ecchymosis is certainly not always an immediate result of a bruise:—it may not appear for six or eight hours, or until after the second day, and in an instance mentioned by Dr. Chowne, where a young woman received a severe blow under the right breast, there was no discolouration of the skin until after the fourth day. In one case of severe injury just related, the individual did not die until after the lapse of thirty-six hours: but there was no ecchymosis. Many cases of the non-production of ecchymosis by violence may be probably referred to the fact, that death takes place rapidly, and before there is time for the effusion of much blood from the minute vessels: but this explanation cannot apply in all cases;—for ecchymosis is often an *immediate* consequence of a severe blow,—it has even been produced by blows on the recently dead body, and therefore it would seem that the continuance of active life was not indispensable to its production (antè, p. 291.)

Many more cases might be adduced in support of the proposition, that ecchymosis is not a necessary or constant result of a severe contusion; but those already related sufficiently establish the fact.

This medico-legal question was raised on a trial before the Justiciary Court of Glasgow, in January, 1837. A woman was found dead in her house, and her husband was accused of having murdered her. There was no mark of violence externally; but on opening the abdomen, the liver was found extensively lacerated, and there was no doubt that this was the cause of death. A medical witness asserted, that as there was no appearance of injury externally, the rupture could not have been caused by a fall or a blow. He attributed the absence of marks of ecchymosis to the rupture having been occasioned by the forcible pressure of some heavy rounded smooth body to the abdomen. The prisoner was acquitted on a verdict of not proven.

The liver is seldom ruptured except from violence directly applied, and it is observed that the rupture is more commonly caused by the sudden, than by the slow application of violence. The explanation given by the witness, would neither account for the rupture nor for the absence of ecchymosis; for these conditions are more commonly met with under directly opposite circumstances. At the same time in cases where the facts are imperfectly known, a surgeon must not be too ready to assume, in the absence of ecchymosis, or abrasion, that violence has been directly applied and caused the rupture of an internal organ. The liver may have been ruptured in the above case either from a blow or a fall,—the absence of ecchymosis in the parietes, is not incompatible with either view.

At the Perth Circuit Court, April, 1836, a woman named Finlay, was indicted for the manslaughter of her husband. The medical evidence established that the deceased, during a quarrel with his wife, had met with a severe compound fracture of the leg; but there was no ecchymosis whatever on any part of the limb. Five medical witnesses deposed, that, in their opinion, the fracture must have been produced by a blow, and not by an accidental fall. In cross-examination, they were required to reconcile this opinion with the entire absence of ecchymosis. One witness said, that a blow adequate to cause simple fracture would produce ecchymosis,—a second that ecchymosis seldom occurred until some hours after such an accident: this explanation, however, was set aside by the fact that the man lived several days, and no ecchymosis appeared. Mr. Syme said, that in an open wound, when the blood was allowed to flow away, there would be no ecchymosis. The others thought that ecchymosis ought to be produced by blows inflicted on any part of the body, and judging from external appearances, they should have supposed that no blows could have been inflicted on the deceased. Mr. Lizars appeared in favour of the prisoner;—he is reported to have said that the fracture had resulted from a fall, and not from a blow. Had it resulted from a blow, he should have expected to find ecchymosis, tumefaction and ruffling of the skin in the vicinity. Such violence as would have produced the fracture, must (?) have caused these appearances. The jury found the prisoner guilty of a minor offence. (Ed. M. & S.J. Oct. 1836.)

In this case, the explanation given by Mr. Syme sufficiently accounted for the non-occurrence of ecchymosis. The absence of this state of the skin could not, however, be said to furnish any evidence of the mode in which the fracture originated. Ecchymosis, if produced at all, may be caused either by a fall or a blow; and as it was admitted, that any force, adequate to produce the fracture, might have caused this appearance, it is impossible to assent to the proposition, that the absence of ecchymosis was any proof that the fracture had been caused by a fall.

CHAPTER XXXI.

BY WHAT MEANS WAS THE WOUND INFLICTED? IF BY A WEAPON, WHAT KIND OF WEAPON?

It sometimes happens on criminal investigations, that a weapon is presented to a medical witness; and he is required to say, whether a wound, found on the body of a person, was produced by it. On the certainty of a weapon having been used, it is not uncommon for prisoners, even when found guilty upon the clearest evidence, to declare that no weapon was employed by them, but that the wound had been occasioned by accidental circumstances. A witness should remember, that he is seldom in a position to swear that a particular weapon produced at a trial, must have been used by the prisoner:—he is only justified in saying, that the wound was caused either by it, or by one similar to it. In reference to this subject, Schwörer relates the following case. A man was stabbed by another in the face, and a knife with the blade entire was brought forward as circumstantial evidence against him,—the surgeon having declared that the wound must have been caused by this knife. The wounded person recovered, but a year afterwards a fistula formed in the face, and the broken point of the real weapon was discharged from the sinus. The wound could not therefore have been produced by the knife which was brought forward as evidence against the prisoner at the trial. (Lehre von dem Kindermorde.) Although the criminality of the act is not lessened or impugned by an occurrence of this kind, it is advisable that such mistakes should be avoided by the use of proper caution on the part of a witness.

Let us now suppose, that no weapon is discovered; and that th opinion of a witness is to be founded only on an examination of th wound. It is right for him to know that on all criminal trials cons derable importance is attached by the law to the fact of a wound hav ing been caused by the use of a weapon; since this often implies ma lice, and in all cases a greater desire to injure the party assailed, than the mere employment of manual force. Some wounds at once indicate that they must have been produced by weapons. This is the case with cuts or stabs. In incised wounds, the sharpness of the instrument may be inferred by the cleanness and regularity with which the edges are cut:—in stabs also, the form and depth of the wound will often indicate the kind of weapon employed. Stabs sometimes have the characters of incised punctures, one or both extremities of the wound being cleanly cut, according to whether the weapon was single or double-edged. Dupuytren has remarked, that such stabs, owing to the elasticity of the skin, are apparently smaller than the weapon, a point to be remembered in instituting a comparison between the size of the wound and the instrument. When a stab has traversed the body, the entrance aperture is commonly larger than the aperture of exit; and its edges, contrary to what might be supposed, are sometimes everted owing to the rapid withdrawal of the instrument. That facts of this kind should be available as evidence, it is necessary that the body should be seen soon after the receipt of the wound, and before there has been any interference with it.

It is important to notice, whether the edges of a punctured wound be lacerated and irregular or incised; because it may be alleged in the defence, that the wound was produced by a fall on some substance capable of producing an injury somewhat resembling it. In a case that occurred to Mr. Watson, a deeply penetrating wound on the genital organs of the deceased, which had evidently caused her death, was ascribed by the prisoners charged with the murder to her having fallen on some broken glass; but it was proved that the edges of the wound were bounded everywhere by clean incisions, which rendered this defence inconsistent, if not impossible. I have known a similar defence made on two other occasions, where the cases came to a trial. In one, a man struck another and knocked him against a window. On examination there were three deep cuts on the face of the prosecutor, but no weapon had been seen in the hand of the prisoner. He was charged with cutting and stabbing. The surgeon deposed that the wounds appeared to have been inflicted with a knife or a razor blade, and not by broken glass. If the wounds had been made by glass, particles of that substance would probably have been found in them; but there were none. The prisoner was acquitted;—the infliction of the wounds by a weapon, not being considered to have been made out. In another case that occurred in August 1841, the prosecutor was knocked down, and his throat was found severely cut; although there was no proof that a weapon had been used. In the defence, it was urged that the wound had been produced by a broken pane of glass; but the surgeon described it as a clean cut five inches in length, and one inch in depth, laying bare the carotid artery. He considered that it must have been done by a razor or knife; and that it was a cut made by one stroke of the instrument.

In general, wounds made by glass are characterized by their great irregularity and the unevenness of their edges. Cases of this kind show that as it is not always possible to know when this sort of defence may be raised, a medical witness should never fail to make a minute examination of a wound which has been criminally inflicted.

A case of murder was tried at the Worcester Summer Assizes, in 1838, in which it appeared in evidence, that the deceased had died from a very small punctured wound in the thorax. It was five inches and a half deep, and it had completely traversed the right ventricle of the heart and led to death by hæmorrhage. The wound was supposed to have been produced by a small skewer, which was found near the spot; but in the defence, it was alleged that the deceased had fallen over a tub, aud,tbat the wound had been caused by a projecting nail. This allegation, however, was negatived by the surgeon, from the fact of its being a clean cut wound. Had it been produced as alleged by the prisoners, the fact would have been indicated by au irregularity of margin.

Lacerated wounds do not in general present more difficulty with regard to their origin, than those which are incised or punctured. The means which produced the laceration, are commonly well indicated by the appearance of the wound. These injuries are generally the result of accident;—they are, however, frequently met with on the bodies of new-born children, in which case they may give rise to charges of infanticide.

Contused wounds and severe contusions present much greater difficulty to a medical jurist. It is not often in his power to say, whether a contused wound has resulted from the use of a weapon, from a blow of the fist, or from the deceased having accidentally fallen against some hard surface. This question is frequently put to medical witnesses on those trials for manslaughter, which arise out of the pugilistic combats of half-drunken men. One of the combatants is generally killed, either by a blow on the head, by a fall, or by both kinds of violence combined. The skull may or may not be fractured; and the person may die of concussion, inflammation of the brain, or from extravasation of blood. The general defence is, that the deceased struck his head against some hard substance in falling on the ground; and the surgeon is asked, whether the particular appearances might not be explained on the supposition of a fall. This in general he admits to be possible, and the prisoner is acquitted.

A medical witness is rarely in a position to swear with certainty, that a contused wound of the head must have been produced by a weapon and not by a fall. Some circumstances, however, may occasionally enable him to form an opinion on this point. If there be contused wounds on several parts of the head, with copious effusion of blood beneath the skin, the presumption is, that a weapon must have been used. If the marks of violence be on the vertex, it is highly probable that they have been caused by a weapon; since this is not commonly a part which can be injured by a fall.

It has already been remarked, that the law attaches great importance to the clear proof of the use of a weapon; and a medical man has therefore a serious responsibility thrown upon him, when, in the absence of a weapon, he is called upon to say from an examination of the wound, whether one had been used or not. The statute on wounding makes no reference to the means by which wounds are inflicted; but the words are held by the judges to imply in all cases, the use of some weapon or instrument. The following are the provisions of the law.

> "Whosoever shall *stab, cut or wound* any person, or shall by any means whatsoever, cause to any person, any bodily injury dangerous to life, with intent in any of the cases aforesaid to commit murder, shall be guilty of felony." (1 Vic. c. 85, s. 2.)

The word stab is held to import a wound from a *pointed* instrument,—the word cut, from an instrument having an edge; and the word wound comprises incised, punctured, lacerated, contused and gunshot wounds:—thus including all stabs and cuts, and rendering the separate use of these words in the statute wholly unnecessary. All medical men know that stabs and cuts are varieties of wounds; and it is difficult to understand why these terms should have been retained, and the other varieties of wounding, as "incise, puncture, lacerate and contuse," omitted. It has been held that an indictment for cutting will not be supported, if the medical evidence prove that the alleged cut was a stab, and *vice versâ*; and further, in an indictment for cutting and stabbing, it is not sufficient to prove, that it was a contused or lacerated wound. Such technical trivialities are in some measure counteracted by multiplying the counts of an indictment:—but this renders the prosecution of such crimes in a great measure a matter of accident; and creates, without any apparent necessity, difficulties in the medical evidence, by which the accused party only can benefit, and the course of public justice suffer. A medical witness may not always be able to swear to the exact boundary by which a stab is separated from a cut, or a cut from a laceration:—the injury might be considered in either light,—or one medical witness might take one view, and another an opposite view. But while they thus differed on a point, which could not in the least affect the real merits of the case as between the prosecutor or the public and the accused, they would both agree that the injury was a *wound*. Such difficulties, it is true, seldom occur in practice; but there is no reason why they should ever be permitted to occur; and it is certainly extraordinary that on the revision of the criminal law of this country in 1837, such anomalies should have been retained.

A severe wound may, however, be inflicted on a person, and yet, not come within the statute of wounding. Thus the teeth, the hands or feet uncovered, have been held by a majority of the judges not to be weapons; and injuries produced by them, however severe, are not considered wounds within the meaning of the act. Parties have been tried on charges of biting off fingers and noses, and the medical evidence has shown, that great disfigurement and mischief had been done to the prosecutor; but in these cases the degree of injury produced—the division of the cutis,—is not so much regarded, as the actual method by which it is accomplished. From a trial which took place at the Nottingham Assizes in 1832, it appears that artificial arms and legs are not exempted under the statute. They are considered to be weapons, although in the case alluded to, a strenuous effort was made by the prisoner's counsel to show, that the wooden arm with which the assault was committed, had become, by long use, part of the body of the prosecutor, and like the natural arm it ought not to be considered a weapon in law! The objection was overruled.

We may be often in doubt whether, in respect to lacerated or contused wounds, a weapon has been used or not. Contused wounds on bony parietes, as the cranium, often have somewhat the appearance of incised wounds, the skin being evenly separated;—still when the wound is recent a careful examination will generally enable a witness to surmount the difficulty. If some time has elapsed before the wound is examined, there will necessarily be great caution required in forming an opinion. The following case was communicated to me by a pupil, who gave evidence on the occasion. It was tried at the Chelmsford Spring Assizes, 1837.

The prosecutor, it was alleged, had been stabbed on the head with a knife. The prisoner struck the blow, and he certainly had a knife in his hand at the time; but whether the wound was or was not produced by the knife could not be determined from the evidence of eye-witnesses. In the defence it was urged, that the prisoner had inflicted the wound with his knuckles, and not with a knife. When the surgeon was called to examine the wound there was so much contusion and laceration about its edges, that it was impossible to ascertain, with the necessary legal precision, by what means it had been caused. There was suspicion, but no proof that a weapon had been employed, and the prisoner was acquitted of felony.

A surgeon should be cautious in listening to the statements of others, that a weapon has been used, unless the wound itself bear about it such characters, as to leave that fact indisputable. During a scuffle, the prosecutor may be easily deceived as to the way in which the accused party inflicted a wound upon him,—or a worse motive may sometimes exist for imputing to an assailant the use of a weapon during a quarrel. In such cases we should, as medical witnesses, rather trust to the appearance of the wound for proof of the use of a weapon than to the account given by interested parties.

In a case which was tried lately at the Chelmsford Assizes, a surgeon swore that a wound on the nose of the prosecutrix, had been produced by a knife, and not by a blow with the fist, as it was alleged in the defence. There seems to have been no good medical reason for the opinion that any knife had been used: it appears to have been founded chiefly on the loose statement of the prosecutrix herself. Nevertheless a conviction followed upon this evidence and a respectable female, charged as accessary, was sentenced to, and is now undergoing a severe punishment, not for having assaulted the prosecutrix for it does not appear that she struck the blow, but for aiding another in the supposed act of stabbing. It was alleged that she gave a knife to the assailant, when it was extremely doubtful, medically speaking, whether any knife had been used. This case appears to me to convey a strong caution in respec to the medico-legal examination of wounds.

A medical man is not justified in giving a hasty opinion of a weapon having been employed from mere hearsay;—he may in this way, lead to the infliction of a very severe but unmerited punishment. The party, when once convicted, cannot have the case re-heard by moving for a new trial, or appealing against the verdict;—and unless ably defended, he must suffer from the mistake thus made by a medical witness.

The use of a weapon on these occasions, may be sometimes inferred from the dress having been cut; although it is quite possible that a contused wound may be inflicted by a bludgeon, through the dress, without tearing or injuring it.

A wound may be indirectly produced by a weapon, and medical witnesses have often been questioned on this point. Thus the prosecutor may at the time have worn about his person, some article of dress, which received the blow, and this may have caused the wound.

On a trial, for maliciously wounding, which took place at the Reading Spring Assizes, in 1837, it appeared in evidence, that the prisoner, while poaching, assaulted a game-keeper, by inflicting on his head, severe blows with a gun. At the time of the assault, the prosecutor wore a strong felt hat, which it was contended in the defence, had caused the wounds that formed the subject of the charge. The medical witness admitted, that the wounds might have been produced either by the hat or the gun. The prisoner was convicted; but the judge intimated a doubt whether this could be considered a "wounding by a weapon" within the statute. In another case, a blow was struck with a bludgeon at the head of the prosecutor, who wore spectacles. Wounds were produced, which it was argued in the defence, had resulted from the glass of the spectacles. The prisoner was acquitted. Every case of this kind must be determined according to the circumstances accompanying it.

One fact appears to me to be well established from the foregoing statements, namely, that a medical practitioner should always make a minute and careful examination of wounds, which are likely to become the subject of criminal charges. Before performing his duties as a surgeon, he is bound, so far as he consistently can, to notice their characters, as a medical jurist.

CHAPTER XXII.

HOW OR BY WHOM WAS THE WOUND INFLICTED?

Supposing that the wound which is found on a dead body, is proved to have been caused before death, it will next be proper to inquire whether it was the result of suicide, homicide, or accident. It might at first sight be considered, that the determination of a question of this nature, was wholly out of the province of a medical jurist. In some instances it may be so, and the settlement of it is then properly left to the legal authorities; but in a very large number of cases, it is so closely dependent for its elucidation on medical facts and opinions, that juries could never arrive at a satisfactory decision, without his assistance.

Let us suppose then, that a medical jurist is consulted in a doubtful case,—What are the points to which he must direct his attention? These are, with regard to the wound, its situation, its nature and extent, and its direction.

I. The SITUATION OF A WOUND. It is a general principle in which most medical jurists seem to agree, that wounds, inflicted by a suicide, are usually confined to the anterior or lateral parts of the body. The throat and chest are most commonly selected where cutting instruments are employed ; while the chest, especially in the region of the heart, the mouth, the orbit and the temples, are the spots generally chosen for the perpetration of suicide by fire-arms. But it is obvious, that any of these parts may be also selected by a murderer, with the especial design of simulating a suicidal attempt ; therefore, the mere situation of a wound does not suffice to establish the fact of suicide. Dr. Smith considers, that if the weapon has been introduced into the deceased's mouth and there discharged, we may almost take it for granted, that "it has not been done by another ;" (For. Med. p. 302 ;) but this inference is rather too hastily drawn ; because it is quite within the range of possibility, that a cool and calculating assassin, may purposely resort to this method of destroying his victim, in order to conceal his crime. In suicidal wounds from fire-arms, a discolouration by powder of the fingers of the hand which discharged the weapon, is sometimes observed ; this has also been looked upon as a source of evidence of suicide under doubtful circumstances, but a similar objection, although not with equal force, might be made to its admission. Some have regarded it as fully established in legal medicine, that when wounds exist at the posterior part of the body, it is a positive proof that they have not been self-inflicted. This situation is certainly such that we may consider it difficult for the suicide to attain ; but, as Orfila observes, it is not the situation, so much as the direction of a wound, which here furnishes evidence against the presumption of suicide. A wound, traversing the body from behind to before in a direct line, is not very likely to have resulted from a suicidal attempt ; at least it must be obvious that it would require more preparation and contrivance on the part of a self murderer, so to arrange matters, that such a wound should be produced, than we can conceive him to possess at the moment of attempting his life. Besides, his object is to destroy himself as quickly and as surely as circumstances will permit ; he is, therefore, not likely t adopt complicated and uncertain means for carrying this design int execution. Nevertheless, we must not always expect to find suicida wounds in, what a surgeon would pronounce to be, the most propo situation to produce instant destruction. A want of knowledge, or want of resolution on the part of a suicide, or the accidental slipping the hand, will often cause a wound in a part where we might least expect to find it.

Wounds which result from accident or suicide are generally in exposed parts of the body. A wound in a concealed or not easily accessible part, is presumptive of murder; because this kind of injury could only have resulted from the deliberate use of a weapon. Suicidal wounds are sometimes found in the most unusual situations. In December, 1842, a surgeon destroyed himself by cutting through the brachial artery and the principal veins of his left arm with a penknife; and in another instance which occurred at a prison in New York in 1839, a young man committed suicide by dividing the arteries of the fore-arm on both sides. It is very rare that we find suicidal stabs in the abdomen or throat, but an instance occurred a few years since, where a woman destroyed herself by a stab in the lower part of the abdomen; and several similar cases are recorded by medico-legal writers. In an attempt at suicide, which fell under my own observation, a stab was inflicted by a carving-knife on the fore-part of the neck traversing the parts from the trachea to the spinal column. In regard to situation, it has been remarked that there is no wound which a suicide is capable of inflicting on himself, which may not be produced by a murderer; but there are many wounds inflicted by a murderer, which, from their situation, and other circumstances, a suicide would be incapable of producing on his own person. We cannot always obtain positive certainty on this point; the facts will often only allow us to speak with different degrees of probability. The situation of a wound sometimes serves to show, whether it be of an accidental nature or not,—a point often insisted on in the defence. All accidental wounds must exist on those parts of the body which are exposed. Some wounds, however, forbid the supposition of accident, even when exposed, as deeply incised wounds of the throat, and gunshot wounds of the mouth and temples.

II. NATURE AND EXTENT OF A WOUND.—Generally speaking, the wound met with on the body of a suicide, where firearms have not been used, is incised or punctured. Contused wounds are rarely seen in cases of suicide, because in producing them there is not that certainty of destroying life which a self-murderer commonly looks to. There are, of course, exceptions to this remark, as where, for instance, a man precipitates himself from any considerable height, and becomes wounded in the fall. Circumstantial evidence will, however, rarely fail to clear up a case of this description. Greater difficulty may exist where life is destroyed by a contused wound, voluntarily inflicted. A case is related by a German author, in which a man first attempted to destroy himself by running with his head against a wall; and not having succeeded in this attempt, he struck himself repeatedly on the forehead with a cleaver. By this he produced such violent injury to the brain, that death soon followed. The man was seen to commit the crime by several witnesses; had this not been the case, the nature of the wound was such as must have excited a suspicion that it had been inflicted by another, and that the man had been murdered.

A close attention to wounds, made by cutting instruments, will sometimes lead to the development of cases, rendered doubtful from the circumstances under which the dead body of a wounded person is found. A few years since, the body of a respectable farmer was found lying on a high road, in one of the midland counties. The throat was severely cut, and he had evidently died from the considerable hæmorrhage which had taken place. A bloody knife was discovered at some distance from the body, and this, together with the circumstance of the pockets of the deceased having been rifled, led to a suspicion of murder. The suspicion was confirmed when the wound in the throat was examined by a surgeon. It was cut, not as is usual in suicides, by carrying the cutting instrument from before backwards, but as the throats of sheep are cut, when slaughtered by a butcher. The knife had been passed in deeply under and below the ear, and had been brought out by a semicircular sweep in front, all the great vessels of the neck, with the œsophagus and trachea, having been divided from behind forwards. The nature of this wound rendered it at once improbable that it could have been self-inflicted; and it further served to detect the murderer, who was soon afterwards discovered. The prisoner, who was proved to have been a butcher, was subsequently tried and executed for the crime.

The nature of the injury must, in some instances, remove all suspicion of suicide. If a dead body is found with the head separated from the trunk, or the trunk separated in two parts, and the wounds are proved to have been made during life, there cannot be a doubt of the act having been homicidal. These are wounds which ex naturâ rei at once remove all suspicion of suicide.

It is necessary to bear in mind, that maniacs, when they commit suicide, often inflict upon themselves wounds of a very extraordinary nature, such as would, at first view, lead to a suspicion that they had been produced by the hand of a murderer; and, therefore, the rules which are here laid down to distinguish homicidal from suicidal wounds, must be very guardedly applied to the cases of those individuals who are known to have laboured under insanity. Perhaps one of the most remarkable cases of this kind, is that recorded by Mr. Tarleton. (Med. Gaz. xxiv. 276.)

A gentleman was found lying in a state of insensibility in the kitchen of his house, with a cleaver by his side. On examining the head, upwards of thirty wounds were found over the posterior portion of the occipital bone. The wounds, many of which were superficial, had a horizontal direction from behind forwards. One, however, had removed a portion of the skull from the middle of the lambdoidal suture, so that the brain had escaped. This person died four days afterwards, but recovered so far as to admit that he had produced the wounds on himself, of which, from other circumstances, there could have been no doubt. He was a lunatic.

This was a most unusual way of committing suicide. Had the deceased been found dead on a public highway, thus wounded, the probability is, that a strong suspicion of murder would have arisen. A case of this kind should be borne in mind when we are called upon to speak to the possibility of certain wounds found on a dead body, having been self-inflicted.

The extent of a wound, by which we are to understand the number and importance of the parts injured, must always in these cases be taken into consideration. It has been somewhat hastily laid down as a rule, that an extensive wound of the throat, involving all the vessels and soft parts of the neck to the vertebral column, could not be inflicted by a suicide. Although in general, suicidal wounds of this part of the body, do not reach far back or involve the vessels of more than one side, yet we find occasionally that all the soft parts are completely divided to the vertebræ. These are cases, in which perhaps with a firm hand, there is a most determined purpose of self-destruction. In a case of suicide, observed by Marc, the weapon had divided all the muscles of the neck, the larynx and œsophagus, had opened the jugular veins, and both carotid arteries, and had even grazed the anterior vertebral ligaments. A wound so extensive as this, is certainly rarely seen in cases of suicide; but there is no ground for the assertion, that these extensive wounds in the throat are at all incompatible with self-destruction.

Incised wounds in the throat are generally set down as presumptive of suicide; but murderers sometimes wound this part for the more effectual purpose of concealing the crime. Circumstances, connected with the form and direction of the wound, often, in such cases, lead to detection; for unless the person attacked, be asleep or intoxicated, resistance is offered,—evidence of which may be obtained by the presence of great irregularity in the wound or the marks of other wounds on the deceased. In some instances, it is extremely difficult to say, whether the wound be homicidal or suicidal,—the medical facts being equally explicable on either hypothesis.

Regularity in a wound of the throat has been considered to be presumptive of suicide. This was the publicly-expressed opinion of Sir Everard Home, in the well-known case of Sellis. The deceased was found lying on a bed, with his throat extensively cut; and the edges of the incision were regular and even. This condition of the wound, it was inferred, repudiated the idea of homicide: but as a general principle, it appears to me to be a fallacious criterion. A murderer, by surprising his victim from behind,—by having others at hand to assist him, or by directing his attack against one who is asleep or intoxicated, or who from age or infirmity, is incapable of offering resistance, may easily produce a very regular and clean incision on the throat. This was observed in the case of Lord William Russell, who was murdered by Courvoisier in 1840. The wound in the throat possessed all that regularity which has been so improperly regarded as characteristic of suicide. Many, indeed, have taken a directly opposite view to that advocated by Sir E. Home; and have contended with more plausibility, that the chief character of a suicidal wound in the throat, is great irregularity from want of steadiness in the hand, during the perpetration of suicide. It is by no means unusual in suicides, to find the cut regular at its commencement, and irregular and uneven at its termination, from the loss of blood which attends the first incision; but it is obvious, that a homicidal wound might possess these characters. In short, from the foregoing remarks, we are, I think, entitled to say, that regularity or irregularity in an incision in the throat, furnishes no presumptive evidence either of homicide or suicide.

A punctured wound, as by stabbing, is more commonly seen in cases of homicide than suicide. Few individuals, if we except lunatics, commit suicide by stabbing themselves,—on the continent, however, suicidal stabs are very frequent. The nature and extent of a wound or other injuries on the person, will sometimes allow us to distinguish very positively, accident from homicide. These personal injuries may be such, that they could not possibly have had a suicidal or accidental origin.

In a case that occurred at Manchester, in October 1836, it was shown by the medical evidence, that seven ribs were fractured on one side of the thorax of the deceased, and five on the other. The person charged with murder, alleged in defence, that he had merely struck the deceased a slight blow, and that the ribs had become broken by an accidental fall, subsequently. The medical witness, however, satisfied the court, that the fall as described by the prisoner was inadequate to the production of such extensive violence; and that even had the deceased fallen on one side, this would not account for the fracture of the ribs on the other.

When, therefore, we find in a dead body, severe injuries referred to a fall, we should search the whole of the body carefully, for marks of violence. The insides of the arms or thighs might present similar marks of injury, which could not possibly be explained on the supposition of an accidental fall. Severe contusions on both sides of the body, or anteriorly and posteriorly, commonly indicate homicidal violence.

A few years ago, I examined the body of a woman, who was alleged to have been murdered by her husband. The body presented the marks of numerous contusions; one arm was completely ecchymosed from the shoulder to the hand. The person charged with the murder, ascribed these appearances to the fact of his wife having accidentally fallen out of bed; but on examining the bed it was found to be only a foot from the floor. A fall from this height, would not account for the presence of such extensive marks of violence; but irrespective of this, a severe contusion was found on the outer side of the opposite thigh, which, from the appearance, must have been produced about the same time as that on the arm. The existence of this second contusion, rendered the defence still less probable; for the woman could not, if she had fallen at all, have fallen on both sides of her body at once; and it was not alleged that she had had more than one fall. In the case of the Queen against Wallis, (Cent. Crim. Court, 1839,) a similar defence was set aside, by the fact that severe bruises were found on the occiput and the temples of the deceased.

III. The DIRECTION of a wound. — The direction of a wound has been considered, by some, to afford presumptive evidence, sufficiently strong, to guide a medical jurist in his inquiry. It has been remarked that in most suicidal wounds which affect the throat, the direction of the cut is commonly from left to right, either transversely or passing obliquely from above downwards: in suicidal stabs and punctured wounds, the direction is commonly from right to left, and from above downwards. In left-handed persons, the direction would, of course, be precisely the reverse. Suicidal wounds are, however, subject to such variation in extent and direction, that it is scarcely possible to generalize with respect to them. Nevertheless, an attention to these minutiæ, may sometimes be of real assistance to the inquirer, especially where the body has not been moved from its position. It is recommended that the instrument with which the wound has been inflicted, should be placed in either hand of the deceased, and the extremity moved towards the wounded part, so that it may be clearly seen whether or not, the direction of the wound could correspond to it in any position. It might happen that neither arm would reach the wounded part, so as to inflict a wound of the particular direction observed; this may be the case in wounds situated on the back.

It is obvious that if a murderer makes an incised wound in the throat from behind, the direction will be the same as that commonly observed in cases of suicide. Again, if the person attacked be powerless, the wound may be deliberately made, so as to simulate a suicidal act; indeed murderers would seldom attack the throat, but with the design of simulating an act of suicide. A homicidal stab, may also take the same direction as one which is suicidal; but this would be confined to those cases, where the murderer was placed behind or aside. If in front of the person whom he attacks, the direction would probably be from left to right; but in suicide, where the right hand is commonly used, it is the reverse. All oblique wounds, passing from above downwards, are common to homicide and suicide; but those which take an oblique course from below upwards, are generally indicative of homicide; it is at least extremely rare, that a suicide, unless a lunatic, thus uses a weapon Homicidal incisions, especially in the throat, are often prolonged below and behind the skin forming the angles of the wound, deeply into the soft parts. Those which are suicidal, rarely possess this character; they terminate gradually in a sharp angle, and the skin itself is the furthest point wounded,—the weapon is not carried either behind, below, or beneath it. Exceptions to these characters may exist; but in a dark and intricate subject of this nature, we have only these limited rules to guide us. The instrument with which the wound is supposed to have been inflicted, should be adapted to the edges of the incision; its sharpness may be compared with the cleanness and evenness of the cut, and its length with the depth of the incision or stab. It is no uncommon occurrence for a murderer to substitute some instrument, belonging to the deceased or another person, for that which he has employed.

Some remarks have been made about the direction of a cut or a stab, varying according to whether the right or the left hand has been used by a suicide. It is important for a medical jurist to be aware, that there are many persons, who are really ambidextrous, i. e., who have equal facility in the use of the right or the left hand. This may not be generally known to the friends of the deceased; and such persons are often pronounced by those who have associated with them to have been right-handed. A want of attention to this point, is said to have been one of the circumstances which led to a suspicion of murder in the case of Sellis. (Wills. Circ. Evidence, 97.) He was found dead on his bed with the throat cut,—the razor was discovered on the left side of the bed; whereas, it was generally supposed and asserted, that he was a right-handed man. The truth was, he was ambidextrous, equally expert in the use of the razor with his left and right hand; and thus the apparently suspicious circumstance of the razor being found on his left side, was at once explained away.

Severe incisions on vital parts do not often happen by accident; but severe punctures and stabs affecting vital organs, have frequently an accidental origin. These stabs arise generally from falls, while the individual is in the act of running, with a pointed instrument in his hand or his pocket. There is one character which, when thus produced, they are commonly observed to possess, namely, that their direction is from below upwards. In this way, the truth of a defence may be sometimes tested, as where a prisoner alleges, that the deceased threw himself, or fell upon the weapon. Homicidal stabs may be likewise directed from below upwards; but this is somewhat rare, and not probable, unless an individual be stabbed by an oblique blow, while in the recumbent posture.

Rules of this kind may appear to be susceptible of but little practical application; yet cases do occasionally present themselves, wherein a close attention to the situation and direction of wounds, may materially assist a medical jurist in forming an opinion.

In a case of alleged murder, which was tried during the present year at the Central Criminal Court, the surgeon deposed, that he found on examining the body of the deceased, a stab on the left side of the chest, near the armpit, about six inches in depth. It had wounded the right lung, and had penetrated obliquely into the right auricle of the heart, passing from left to right. He contended, very properly, that considering the situation and direction of the wound, it was very improbable the deceased could have inflicted it upon himself. The fact that there may be some instances in which rules of this kind will not be applicable, must not deter us from endeavouring to make a cautious application of them in doubtful cases.

The following case is of some interest in a medico-legal view:—In May, 1843, a man was brought to Guy's Hospital, with a punctured wound in the back, between his shoulders. It had been inflicted by a stonemason's chisel. The instrument had penetrated to its head, which had prevented it from going further, and had entered the chest, producing a severe wound as it was supposed of the lungs, attended with copious hæmorrhage. It appeared that the man had been drinking and quarrelling with some companions. He had fallen from a blow, but did not complain of being stabbed, and was conveyed home. His wife, on removing his coat, found that his waistcoat and shirt had been penetrated by the chisel, which was still sticking in his back, but the outer coat had not been cut or perforated by it. She withdrew the instrument, when violent hæmorrhage came on, and he was sent to the hospital. The person with whom he had fought was charged with having stabbed him; and it was clear that such a stab must have been either homicidal or accidental. It was elicited from witnesses, however, that no weapon was seen in the hands of the accused,—that the chisel belonged to the wounded party, and that he used it in his trade as a stonemason; there were no marks of blood on the floor where he fell, or on his clothes; that after leaving the public-house, where the quarrel took place, he walked with a policeman, who said that the man exhibited no signs of having been wounded, and did not complain of having been struck by any weapon. These facts seemed to show, that the stab must have taken place after the quarrel; it was further proved, that the wounded man had the chisel in his pocket before the quarrel, and that as the outer coat had not been cut, a homicidal stab could only have been inflicted by the assailant raising this; and then it would remain to be explained how the weapon could have penetrated up to its head.

From the whole of the facts, it was considered that this must have been an accidental stab; although its direction, as such, was remarkable, since, according to the wife's statement, the weapon had not entered the body in a slanting direction, but straightforward, and it required considerable force to remove it. The man recovered, and from the statement which he made, there could be no doubt that it was an accidental stab, produced by a fall; but it was certainly extraordinary, that it should have been found in such a situation and taking such a direction. On these investigations, some regard must always be had to the helpless state of intoxication in which a wounded person may be. This may give an anomalous character to accidental stabs or punctures.

IV. THE PRESENCE OF SEVERAL WOUNDS.—In suicides, commonly one wound only is seen, namely, that which has destroyed life; and the presence of several wounds on a body, or the marks of several attempts around the principal wound, have been considered to furnish presumptive evidence of murder. But it need hardly be observed, that any inferences of this kind must be very cautiously drawn; since not only may a murderer destroy his victim by one wound, but a suicide may inflict many, or leave the marks of several attempts, before he succeeds in his purpose. A case is reported in which a gentleman, labouring under mania, attempted to destroy himself. Besides many wounds on the fore-arm, neck, and face, which disfigured him, there were twenty-two in front of his chest. One of these had traversed the heart, producing death after some hours, by causing extravasation of blood. (Lancet, July 1839.) In incisions on the throat, from ignorance of the situation of vital parts or from tremulousness, a suicide often leaves one or more incisions of greater or less extent, near that which destroyed him. This is especially the case, when the instrument happens first to lodge on the cartilages of the larynx. The same remark applies to suicidal stabs, when the point of the weapon, in being directed against the chest, comes in the first instance in contact with the ribs.

With respect to the throat, many cases might be cited, where two, three, and even six or more incisions, have been made in this part by suicides, before they have destroyed themselves.

A very remarkable case is related by Dr. Handyside, (Ed. Med. and Surg. Jour. Jan. 1838,) in which a gentleman, who had studied medicine, destroyed himself by inflicting several wounds on his throat. Incisions were found on each side, just below the angle of the jaw, and in the hollow behind it. They were irregular in form, and bore the character of deep stabs. The only important vessel divided, was the internal jugular vein on the right side; but, nevertheless, a large quantity of blood was lost, and this, no doubt, as it is stated by Dr. Cormack, was the real cause of death. The case is in many points of view singular; for such wounds have never before, so far as I know, been found in cases of suicide. It would appear that the deceased was ambidextrous, and that the wounds on each side of the neck were inflicted by the hand of the opposite side.

The following case which occurred in London, in 1839, is somewhat similar. A lady who had been for several days in a despondent state, was found one morning dead in her bed in a sitting posture. On examination, two very deep and extensive wounds, which had divided the principal blood-vessels, were perceived on the right side of the neck. There were two penknives on the bed, covered with blood. From the situation and other characters of the wounds, it was inferred that they must have been inflicted with the left hand; although nothing satisfactory could be ascertained on this point. The husband and son had slept in an adjoining room. There was no doubt that this was a case of suicide, although it is singular, that two deep wounds should have been found thus inflicted by two different weapons on the right side of the neck in the case of a person who was not known to be left-handed.

In general, suicides when foiled in a first attempt, continue to use the same weapon; but sometimes, after having made a severe incision in the throat, they will shoot themselves, or adopt other methods of self-destruction. These cases can only appear complicated to those, who are unacquainted with the facts relative to self-murder. Neither the presence of several wounds by the same kind of weapon, nor of different wounds by different weapons, can be considered of themselves, to furnish any proof of the act being homicidal. One instance has been already related, in which a lunatic, in committing suicide, inflicted thirty wounds upon his head. (Ante, p. 308.)

In a case of murder, when many wounds are found on a dead body, it may happen that the situation or direction of some, will be incompatible with the idea of a suicidal origin.

The following case occurred at New York, in September 1839. A woman was found dead, and there were many wounds upon her body. The husband was suspected of having killed his wife, but he asserted that she had destroyed herself. This defence, however, was shown to be inconsistent with the medical facts. Three physicians who examined the body, deposed that there were eleven wounds (stabs,) eight on and about the left side of the thorax, one of which had penetrated the pericardium, and divided the trunk of the pulmonary artery at its origin; and the others were on the back, near the left scapula. It was quite impossible, that these last-mentioned wounds could have been produced by the deceased, and there was every reason to suppose that the stabs in front and at the back, had been inflicted at the same time by the assassin.

When we find on the body of a suicide, several wounds, it generally happens that one only bears about it a mortal character, namely, that which has caused death. On this account, it has been asserted by some medical jurists, that when two mortal wounds are found upon a body, and particularly if one of them be of a stunning or stupefying tendency, (i. e., affecting the head,) they must be considered incompatible with suicide.

An inference of this kind can be applied to those cases only, in which the two wounds, existing on different parts of the body, were likely to prove immediately fatal. It must, however, be borne in mind, that all suicides do not immediately perish from wounds which are commonly termed mortal; on the contrary, they have often the power to perform acts of volition and locomotion, which might by some, be deemed wholly incompatible with their condition. It is very difficult to say, whether one wound was likely to destroy life so rapidly, as to render it impossible for an individual to have inflicted another upon himself. There are no rules by which, in unknown cases, the instantaneous mortality of wounds, can be accurately determined,—a fact which will be apparent hereafter from a description of cases of wounds of the head, heart and throat. In the mean time the following case, reported by Orfila, will show what may occasionally be met with in suicide.

A gentleman was found dead in his chamber. Two pistols were lying in the room,—one near the body, and the other on the bed, at some distance from it. An investigation was made on the spot, and it was then discovered that the deceased had shot himself in two places. One wound, which had apparently been inflicted while he was lying on the bed, had completely traversed the left side of the chest, breaking a rib before and behind, perforating the lung through its middle portion, and passing near to the roots of the pulmonary veins. A very large quantity of blood had become extravasated in the thorax. In spite of the existence of so serious an injury, it appeared that the deceased must have risen from his bed, walked to a closet to procure another pistol, with which he produced a second wound that must have proved instantly mortal. The ball had entered at the frontal bone, and, after traversing the left hemisphere of the brain, had become lodged against the os occipitis. There was not the least doubt of this having been an act of deliberate suicide.

This case should inspire caution in the expression of an opinion: but at the same time, it is to be remarked, that such occurrences are rare: the existence of several mortal wounds on a subject, i. e., wounds which would commonly be considered sufficient to produce immediate death, affords a presumption of homicide, which is open to be confirmed or rebutted by other circumstances.

Again, it is not possible to say from the mere discovery of marks of contusion or injury on the head, that the deceased must have necessarily laboured under concussion, and have therefore been afterwards unable to inflict any other wound upon himself. Injuries of the head are attended with the most singular anomalies in this respect. One individual will be rendered insensible and powerless from a blow, which leaves scarcely any appreciable marks, while another will be able to walk and exert himself, when the skull has been fractured and depressed, and even when a portion of brain has been lost; in short, the appearances may be such, as to induce many surgeons to express an opinion, that death must have taken place instantaneously. It is quite right, that a medical jurist should be fully prepared for the occurrence of such anomalous cases; but a strong suspicion of homicide may fairly exist where, besides marks of great injury to the head, a severe cut or a stab, is found on the body. A man is not likely to cut or stab himself after having sustained such severe violence to the head; but it is quite possible that he may have the power of precipitating himself from an elevated spot, and thereby produce great injury to the head, after having previously attempted to cut his throat or to stab himself. That this may happen, will be apparent from the following case, which occurred in this city in 1836.

A man was found one morning lying dead in the street of a low quarter of the town, with his skull severely fractured, and his throat cut. The evidence adduced at the inquest, satisfactorily showed, that the deceased had attempted suicide by cutting his throat in his bed-room, and had then thrown himself out of the window, by which the fracture and other severe contusions, found on his body, were produced. Had the body of this person been thus discovered in a lonely and sequestered spot, the presumption would certainly have been in favour of murder. Cases of this description are usually determined by circumstantial evidence.

In the following instance there could be no doubt of homicide. A woman was found dead nearly twelve months after she was first injured. Her body was clearly identified. A handkerchief was drawn tight round the neck, and a wound from a pistol-ball was traced through the left side of the chest, passing out at the right orbit; and three other wounds were found, one of which had entered the heart, and all of which had been made by a sharp instrument. The prisoner charged with the crime, alleged that the deceased had committed suicide—but the variety of the means and the instruments employed to produce death, as well as the fact that the gun-shot wound in the head, the stab in the heart, and the act of strangulation were individually sufficient to account for speedy death, left no doubt that this was an act of murder. (The King against Corder, Bury Summer Assizes, 1828. Will's Circ. Evidence, 237.)

When several wounds are found on a dead body, the question is frequently asked,—Which was first received? If one be what is commonly called mortal, and the others not, it is probable that the latter were first inflicted. This remark applies both to cases of homicide and suicide; but it is apparent, that where in a murderous assault, a person has been attacked by several individuals at once, the wounds may have been simultaneously produced. This is, however, a question to which it is not easy to give a general answer. Each case must be decided from the special circumstances attending it; and in most instances, unless some direct evidence be afforded, a medical opinion can be little more than conjectural. I here refer to it, because it is a question almost always put in a court of law; and a witness should at least prepare himself for it, by a proper examination of the medical circumstances of the case.

CHAPTER XXXIII.

CIRCUMSTANTIAL EVIDENCE.

In pursuing the examination of the question respecting the homicidal or suicidal origin of wounds, I shall call the attention of the reader to the force of evidence which is sometimes derived from the circumstances under which the body of a person, dead from wounds, is discovered. It may be said that this is a subject wholly foreign to the duties of a medical jurist, but I cannot agree in this sentiment;

there are very few in the profession, who, when called to aid justice, by their science, in the detection of crime, do not seek for circumstances by which to support the medical evidence required of them. A practitioner would certainly be wrong to base his professional opinion exclusively on circumstantial proofs; but it is scarcely possible for him to avoid drawing an inference from these, as they fall under his observation, for or against the prisoner. His evidence may be of itself weak, and insufficient to support the charge against an accused party; in such a case, if any suspicious circumstances have come to his knowledge, he may be often unconsciously induced to attach greater importance to the medical facts than he is justified in doing; in short he may, through a feeling of prejudice, which it is not always easy to avoid, give an undue force and value to the medical evidence. But if a proper degree of caution be used in drawing inferences from the circumstantial proofs, and they are not allowed to create a prejudice in his mind against a prisoner, a practitioner is, I think, bound to observe and record them; for being commonly the first person called to the deceased, many facts, capable of throwing an important light on the case, would remain unnoticed or unknown, but for his attention to them. The position of a dead body,—the distance at which a knife or pistol is found,—the direction of the instrument,—whether situated to the right or left of the deceased,—the marks of blood about the person, clothes, or furniture of the apartment, are all circumstances which must assist materially in developing the real nature of a case, and giving force to a medical opinion. Many of these circumstances can fall under the notice of him only who is first called to the deceased; and, indeed, if observed by another, no advantage could be taken of them without the assistance of a medical man. Thus, he may be asked: Is the position of the wounded body that which a suicide could have assumed? Is the distance of the fatal weapon from the body, such as to render it improbable that it could have been placed there by the deceased?—in answering either of which questions, he must take into consideration the extent of the wound, and the period at which it probably proved fatal. Again, it may be inquired: Has the deceased bled in more places than one?—Are the streams of blood all connected?—Are there any marks of blood on his person or clothes, which he could not well have produced himself? These are questions, the answers to which may materially affect the case of an accused party; and the practitioner, in noticing and recording the circumstances involved in them, ought therefore to exercise due caution and deliberation. "The consideration of the nature of circumstantial evidence," observes Starkie, "and of the principles on which it is founded, merits the most profound attention. It is essential to the well-being at least, if not to the very existence of civil society, that it should be understood, that the secrecy with which crimes are committed, will not insure impunity to the offender. At the same time, it is to be emphatically remarked, that, in no case, and upon no principle, can the policy of preventing crime, and protecting society, warrant any inference which is not founded on the most full and certain conviction of the truth of the fact, independently of the nature of the offence and of all extrinsic considerations whatever. Circumstantial evidence is allowed to prevail to the conviction of an offender, not because it is necessary and politic that it should be resorted to, but because it is in its own nature capable of producing the highest degree of moral certainty in its application. Fortunately for the interests of society, crimes, especially those of great enormity and violence, can rarely be committed without affording vestiges by which the offender may be traced and ascertained. The very measures which he adopts for his security, not unfrequently turn out to be the most cogent arguments of guilt. On the other hand, it is to be recollected, that this is a species of evidence which requires the utmost degree of caution and vigilance in its application; and, in acting upon it, the just and humane rule, impressed by Lord Hale, cannot be too often repeated:—tutius semper est errare in acquietando quam in puniendo, ex parte misericordiæ quam ex parte justitiæ." (Vol. i. p. 480.)

There are many cases on record in which an observance of slight and unexpected circumstances by medical men, has led to the detection of offenders. In the life of Sir Astley Cooper, it is mentioned, that when called to see Mr. Blight, of Deptford, who had been mortally wounded by a pistol shot in the year 1806, he inferred from an examination of the localities, that the shot must have been fired by a left-handed man. The only left-handed person near the premises, was a Mr. Patch, a particular friend of the deceased's, who was not in the least suspected. This man was afterwards tried and convicted of the crime, and made a confession of his guilt before execution.

Among the circumstances to which a medical witness should specially direct his attention, are the following:

I. THE POSITION OF THE BODY.—The body may be found in a position, which the deceased could not have assumed on the supposition of the wound being accidental or suicidal. The position of a dead wounded body, is often only compatible with homicidal interference, either at the time of death, or immediately afterwards. In order to determine the probable time of death, we should always notice whether there be any warmth about the body,—whether it be rigid, or in a state of decomposition, and to what degree this may have advanced.

II. THE POSITION OF THE WEAPON.—If a person has died from an accidental or self-inflicted wound, likely to cause death either immediately or within a few minutes, the weapon should be found either near the body or within a short distance. If found near, it is proper to notice on which side of the body it is lying; if at a short distance, we must consider whether it might not have fallen to the spot, or been thrown or placed there by the deceased. If there has been any interference with the body, all evidence from the relative position of it and the weapon, will be inadmissible. In a case which was referred to me some time since, a woman had evidently died from a severe incision on the throat, which was homicidally inflicted; the weapon, a razor, was found under the left shoulder, a most unusual situation, but which, it appears, it had taken from the body having been turned over before it was seen by the surgeon who was first called. We must remember, that it is quite compatible with suicide, that a weapon may be found at some distance or in a concealed situation.

In a case of suicide, which occurred in France, in Oct. 1836, a man was found dead in his apartment, with a discharged pistol in his pocket. He had shot himself in the abdomen, and death had taken place from hæmorrhage. Still he had had sufficient power to place the pistol in his pocket, after inflicting the wound.

It must be admitted, that an occurrence of this kind is very unusual; and that where the hæmorrhage proceeds from some incision or stab, involving large arteries or veins, it is wholly improbable that the party should have sufficient power to dispose of the weapon; it will be found either grasped in his hand, or lying by his side. In one instance, it is stated the deceased was discovered in bed with his throat cut, and the razor lying *closed* or shut by his side. It appears very improbable, that any person committing suicide after dividing one or both carotids with the jugular veins, should have power to close or shut the razor, and there is fair ground to suspect murder as in the case above referred to, when a razor is thus found closed, and the body has not been interfered with.

There is, however, one circumstance in relation to a weapon strongly confirmative of *suicide.* If the instrument be found still firmly grasped in the hand of the deceased, no better circumstantial evidence of suicide can, perhaps, be offered. It is so common to find knives, razors and pistols grasped in the hands of suicides, that it is quite unnecessary to produce cases illustrative of this statement. The grasping of a weapon appears to be owing to muscular spasm persisting after death, and manifesting itself under the form of what has been called cadaverous spasm, a condition quite distinct from rigidity, although often running into it. It does not seem possible that any murderer could imitate this state, since the relaxed hands of a dead person cannot be made to grasp or retain a weapon, like the hand which has firmly held it by powerful muscular contraction, at the last moment of life.

A case occurred in France, in 1835, in which the retention of a pistol in the hand of the deceased, was improperly considered to indicate murder. The deceased was found dead, sitting in a chair by the side of the bed, his left elbow resting upon the bolster, and his right hand which lay over the right thigh, grasping a recently discharged pistol. The temperature of the body indicated, that the deceased had not been dead above two hours. He had evidently died from a severe gun-shot wound of the head. The son, who slept in the same room with the deceased, was accused of having murdered him, and of having placed the pistol in the hand of his parent after death, in order to give the appearance of suicide. This appeared so much the more probable to those who first discovered the body, because when the hand with the pistol, was carefully carried to the position in which the weapon must have been held by the deceased to have committed the fatal act himself, and the hand was afterwards allowed to fall by its own weight, the pistol each time fell from the hand to the floor. There were also some moral circumstances against the son. The physician having duly reflected on the position in which the deceased was discovered, satisfactorily accounted for the hand retaining the pistol after death, by the contractile state of the muscles, continuing under the form of cadaverous spasm. The experiments performed by placing the pistol in the hand of the deceased after this spasmodic contraction had been once destroyed, proved nothing. The accused was discharged. (Ann. d'Hyg. 1836, 467.)

If the weapon cannot be discovered, or if it be found concealed in a distant place, this is strongly presumptive of homicide, provided the wound be of such a nature as to prove speedily fatal. In the case of Lord William Russell, no weapon could be discovered, and although the wound in the throat bore some of the characters of a suicidal incision, this fact alone was sufficient to show that it must have been the act of a murderer.

With respect to the weapon being found at a distance from the body, other circumstances should be taken into consideration, before any opinion is expressed.

We may observe, whether the weapon, if a sharp cutting instrument like a razor, has been recently notched; for this might show that a degree of force or violence had been used, not easily reconcilable with the suicidal use of the instrument. The well-known case of the Earl of Essex, who was found dead in the Tower, in July 1683, gave rise to a doubt on this point. The deceased was discovered with his throat cut, and a razor lying near him. This razor was found to be much notched on the edge, while the throat was smoothly and evenly cut from one side to the other, and to the vertebral column. Some considered this to have been an act of suicide, others of murder. Those medical witnesses, who supported the view of suicide, were asked to explain how it was that such an even wound could have been produced by a notched razor. They attempted to account for this by asserting, that the deceased had probably drawn the razor backwards and forwards across the neck bone, forgetting that before this could be done by a suicide, all the great vessels of the neck must have been divided!

It does not always happen, that the weapon with which a wound has been produced, is covered with blood. It has been remarked, that in the case of stabs, the knife is frequently without any stains of blood upon it; or there is only a slight film, which, on drying, gives to the surface a brown colour. The explanation of this appears to be, that the weapon, in being withdrawn, is sometimes cleanly wiped against the edges of a wound in the integuments.

III. Marks of blood.—It is proper to notice all marks of blood on the person or in the apartment, and to observe where the greatest quantity of blood has been effused; this is generally found in the spot, where the deceased has died. The deceased may have bled in more places than one: if so, it becomes important to notice, whether there be any communications in blood between these different places. Blood on distant clothes or furniture, will show, whether the deceased has moved about; and whether he has struggled much after receiving the wound. Acts of locomotion in a wounded person, who has died from hæmorrhage, are generally indicated by tracks of blood. We must observe likewise, whether if the wound be in the throat, blood has flowed down in front of the clothes or person; for this will sometimes show whether the wound was inflicted when the individual was standing, sitting, or lying down. If the throat be cut, while a person is lying down, it is obvious that the blood will be found chiefly on either side of the neck, and not extending down the front of the body. Few suicides cut the throat while in the recumbent posture, and the course which the blood has taken, may, therefore, be sometimes rendered subservient to the distinction of a homicidal from a suicidal wound. The position in which the body was, when the wound was inflicted, is a frequent question on inquests and criminal trials. In the case of Lord William Russell, the throat had evidently been cut while the deceased was lying in bed; the blood was effused on each side of the neck only. There was also found a wound on the thumb of the right hand of the deceased, which must have been inflicted at the time the hand was put up to defend the throat. Recent wounds on the back of one or both hands, when found in persons who have died from a wound in the throat, are cæteris paribus strongly presumptive of homicide.

In suicidal wounds of the throat, we frequently find the head of the deceased hanging over or near a vessel placed purposely to receive the blood.

It is possible that the throat of a person while standing, sitting, or kneeling, may be cut by a murderer from behind, and thus in appearance simulate suicide. It does not, therefore, follow that on these occasions, the clothes of the assassin would be necessarily covered by blood; for whenever the attack is made from behind, few or no stains may be found upon his dress. This, of course, must depend upon his position in relation to the deceased at the time of inflicting the wound. When the deceased has been wounded with his clothes on, we should notice whether or not any part of his dress has been cut or injured over the situation of the wound. When, together with the wound in the throat, we find the cravat and the shirt cut through, or any part of the dress, this is, all other circumstances being equal, presumptive of homicide; for it is not usual that any suicide, unless labouring under confirmed insanity, would be likely to allow any mechanical obstacles of this kind to remain in the way of a weapon. In one case of a homicidal wound in the throat, inflicted in the recumbent posture, the cravat of the deceased had been lifted up and afterwards allowed to drop over the wound.

Marks of blood on the person of the deceased require special observation. Very often the impression of a hand or of some of the fingers, will be found on the skin in a situation where it would have been improbable or impossible for the deceased to have produced it, even supposing that one or both of his hands were covered with blood.

In one case of murder, there was found the bloody impression of a left hand upon the left hand of the deceased, in such a situation, that it was quite impossible the deceased himself could have made the mark.

In judging from marks of blood in the apartment, we must take care that we are not unconsciously misled by the accidental diffusion of this liquid by persons going in and out.

The following case, which will show the necessity of extreme caution, occurred recently in France. A young man was found dead in his bedchamber, with three wounds on the front of his neck. The physician who was first called to see the deceased, had, unknowingly, stamped in the blood with which the floor was covered, and had then walked into an adjoining room, passing and repassing several times; he had thus left a number of bloody foot-prints on the floor. No notice of this was taken at the time; but on the following day, when the examination was resumed, the circumstance of the foot-prints was particularly attended to, and excited a suspicion that the young man had been murdered. The suspected person was arrested, and would have undergone a trial on the charge of murder, had not M. Marc been called in, to examine all the particulars of the case. A similar circumstance occurred in the case of Eliza Grünwood, who was murdered at Lambeth, in June 1838.

It is scarcely possible to distinguish arterial from venous blood, when it has been for some time effused and has fallen upon articles of dress or furniture; but this in medico-legal practice is a matter of little moment, since there are few cases of severe wounds, either in the throat or other parts of the body, in which the two kinds of blood do not escape simultaneously. The most striking and apparent difference between them, is the colour—the arterial, being of a bright scarlet, while the venous, is of a deep red hue; but it is well known, that the latter, when exposed to air for a short time, acquires an arterial colour. If the coat or other stuff, covered with blood, were of a dark colour, the liquid would be absorbed and lose its physical characters. Chemistry does not enable us to apply any test, so as to make a satisfactory distinction between them.

The only case in which this question ever arose to my knowledge, was in that of Sellis, who attempted to assassinate the Duke of Cumberland, and then destroyed himself. Sir Everard Home undertook to say, that the marks of blood on the coat of Sellis, had evidently proceeded from a wounded artery, and that the blood had probably come from the temporal artery of the Duke, which had been divided in the struggle. This distinction appears to have been founded on the fact, that the blood poured out from an artery becomes sprinkled over a surface, and that it does not fall in a gushing stream, like hæmorrhage from a vein. (Will's Circ. Ev. 98.)

Such a criterion appears to me to be scarcely available for practica purposes; since accident may lead to the sprinkling of blood from wounded vein, while blood may be poured out in considerable quantit from an artery, especially if large, and falling on one spot at a shor distance, it may produce a soaked appearance. The sprinkling may b expected only when the wounded artery is small, and the blood fall at a distance. This is a fact which a medical jurist should not ove look, although for the reasons stated too great a reliance must not b placed on it.

When spots of blood are found upon articles of furniture, the form of the spots may sometimes serve to give us an indication of the position of the wounded person with respect to them. Thus when the form of a spot is oval, and elongated, the presumption is that the person was placed obliquely with respect to the stained furniture, during the hæmorrhage. (Ann. D'Hyg. 1840, 397.)

In these investigations it is not often that any difficulty is experienced in distinguishing a suicidal from an accidental wound. When the wound has really been suicidally inflicted, there are generally to be found about it very clear indications of design; and the whole of the circumstances are seldom reconcilable with the supposition of accident. But if any of the relations of the deceased with surrounding objects, have been disturbed,—if the weapon has been removed, and the body transported to a distance, then it will not always be easy to distinguish a wound accidentally received, from one inflicted by a suicide or a murderer. The evidence of those who find the body can alone clear up the case; and the medical witness may be required to state how far this evidence is consistent with the situation, extent and direction of the wound by which the deceased has fallen. It is unnecessary to dwell further on this subject, since the observations made in the preceding pages, will suggest to the practitioner the course which he has to pursue. Circumstantial evidence is commonly sufficient to show whether a wound has been accidentally received or not; but as an accidental wound may sometimes resemble one of homicidal or suicidal origin, so it follows that it is not always possible for a medical jurist to decide the question peremptorily from a mere inspection of the wound. Homicide is only liable to be confounded with accident in relation to contusions and contused wounds. In cuts and stabs the evidence of design will be in general too apparent to allow of any doubt being entertained upon the real origin of the injury. It would not be difficult to produce many instances where murderers, in their defence, have alleged that the wounds observed in the bodies of their victims were of accidental origin, and the allegations have been clearly refuted by medical evidence. A witness must be prepared, therefore, in all cases where death has taken place in secrecy, and the nature of the wound is such as to render its origin doubtful, to be closely examined by the counsel of a prisoner charged with felonious homicide, as to whether the wound might not have been accidental. Our law requires that it should be rendered evident to a jury, before such a charge can be sustained, that the fatal wound could not have been accidental or suicidal. Hence this preliminary question is deserving of serious attention from a medical jurist.

The death of a party, from wounds, has been hitherto considered as a subject connected with a criminal charge; but an investigation of the circumstances under which death ensues, is occasionally rendered necessary when the deceased has effected an insurance upon his life. A policy of life-insurance is rendered void by the act of self-destruction; and therefore an individual, bent on suicide, might, for the sake of his family, take precautions to conceal the manner in which he intended to destroy himself. His body might be found wounded in a way which would render it uncertain whether he had been wounded accidentally, whether he had been murdered, or whether he had fallen by his own hand. In a disputed case, it is incumbent on the office to prove the act of suicide, while the relatives of the deceased would attempt to show the contrary. Such litigation must, of course, call forth a most deep and searching investigation into all the circumstances connected with the death of an insured party, and the whole case would, in some instances at least, rest almost exclusively on medical evidence.

Numerous cases have of late years occurred in England, which will illustrate the importance of attending to the precise characters of wounds, and the circumstances under which the body of a wounded person is found. The limits of this work will not allow me to do more than advert briefly to a few of the more remarkable of these.

In the year 1837, Mr. Dodd, of Chichester, communicated to me the following case. He was called to examine the body of a woman, who was found dead with her throat cut. The deceased, when seen by him, was lying on her back, and the razor with which the wound was inflicted, was found under the left shoulder. On inquiry, it was ascertained that when first seen, she was lying on her face, and the body had been turned round on its back. Blood had evidently run down the fore-part of her person, rendering it probable that she had been wounded while in the erect position. The incision in the throat was deep and extended obliquely from the right side of the chin, to within about an inch of the left collar-bone. It had divided the windpipe, the gullet, all the muscles of that side of the fore-part of the neck,—the carotid artery, jugular vein, and the muscles on the fore-part of the spine, penetrating even into the bodies of the cervical vertebræ. The incision was double, one superficial close under the chin, and the other, the deeper one, appeared to be continued from this. The deepest part of the right end of the incision was nearly three inches in a direct line behind the right angle of the wound, so that it extended at that part behind and beneath the sound skin. The cut was four and a-half inches long, and two and a-half deep. The main question was, whether this could have been a suicidal wound, inflicted by the razor, the only weapon found near the body Considering its characters, Mr. Dodd inferred that it must have been inflicted by another person, and not by the deceased upon herself. The deceased was right-handed, which would add to the difficulty of supposing the wound to have been suicidal. The inference drawn was the only one which the medical circumstances appear to me to justify.

A case of some interest occurred at Brighton in April, 1830. A woman was found lying dead in her bed with her throat cut. She was on her right side, and the bed-clothes were drawn up over her face. A clean razor, shut, was found upon the bed; and another razor, also shut, was found upon the top of the bedstead:—this last appeared as if it had been purposely wiped, and there were some stains of blood upon the handle. A minute examination of the body was made. There was an incised wound in the throat, which had the appearance of having been produced by three distinct cuts. It was situated below and behind the angle of the jaw on the right side. It was two inches in depth, and had divided the superficial muscles, the jugular veins, and some of the branches of the carotid artery. This wound had evidently been inflicted while the deceased was lying down. The chief medical question was whether, under the above circumstances, the deceased could have produced the wound,—have put away the razor, and afterwards covered herself with the clothes. The medical witnesses properly answered, that it was in the highest degree improbable that this could have been an act of suicide.

When the question is, whether the injury resulted from accident or homicide, in relation to contused wounds, there are many difficulties which medical evidence, taken by itself, can seldom suffice to remove.

A case was tried at the Warwick Spring Assizes in 1808, which not only in this, but in some other points of view is of great medico-legal importance. In this instance, the deceased was found dead in a stable, not far from a vicious mare, and the traces of this animal were upon his arms and shoulders. The brother of the deceased was tried on the charge of having killed him with a spade, which was found lying in the stable. This spade was stained with blood; but the evidence from this fact was wholly set aside by the circumstance, that the spade had been subsequently used in cleaning out the stable. In the defence, it was alleged, that the deceased had been kicked by the mare while attempting to put on the traces, and had thus been accidentally killed. According to the medical evidence, there were two straight incised (?) wounds, apparently caused by a blunt instrument, on the left side of the head, one about five, and the other about two inches long. On the right side of the head there were three irregular wounds of a mixed lacerated and incised character, two of them about four inches in length. There was also a wound on the back part of the head, about two inches and a half long. There was no tumefaction round any of the wounds, the integuments adhering firmly to the bone. The right side of the skull was generally fractured,—the fracture extending along the back of the head to the left side,—a small portion of the temporal bone having come away. The deceased was found with his hat on, which was bruised, but not cut; and there were no wounds on any other part of his body. Two medical witnesses expressed a strong opinion, that the injuries could not have been produced by kicks from a horse, grounding that opinion principally on the distinctness of the wounds—the absence of marks of contusion,—the firm adherence to the integuments and the straight lateral direction and similarity of the wounds. They also thought that they could not have been inflicted without cutting the hat, if this had been on the deceased's head at the time; and if the hat had been off, that he could not have had the power to put it on after receiving the wounds. The case was not made out against the prisoner, and he was acquitted. (Wills Circ. Evidence, 302.)

Taking the facts as they are here reported, there seems to be no good medical reason for assuming that the wounds on the head were homicidally inflicted. The fact that they had a somewhat incised character, is not a positive proof that the spade was used in producing them; since instances have occurred where the skin of the scalp presented a similar incised appearance from the kick of a horse; and I believe it will not be found a very unusual consequence of a severe and sudden blow in those parts of the body where the skin is stretched over round surfaces of bone. In this case, another question arose, namely, whether wounds of this description could be inflicted on the head without cutting the hat. Admitting it to be improbable, that the deceased placed the hat on his head after being thus wounded, we must infer that it was on his head at the time, and admitting that the injury was produced by the bruising violence of a horse's hoof, it is easy to understand that the scalp might be wounded without causing more than an indentation in the hat. Had the spade been used, it is less likely that the hat would have escaped. Hence the witnesses who assumed that the deceased had been killed by the spade, were obliged to suppose that the hat must have been off and put on afterwards, therefore that there must have been murderous interference. This, however, would not explain the fact, that the hat was indented over the situation of the principal injury. On the whole, this seems to have been really a case of accidental death.

It is of some importance as a medico-legal fact, that the skin may be wounded through the dress, without the latter being necessarily cut or torn. Mr. Baron Wood, who tried the above case, stated at the time that he remembered a trial at the Old Bailey, where it had been proved that a cut and a fracture had been received without having cut the hat of the wounded person; and evidence was then adduced of the infliction of a similar wound without cutting the hat.

The question whether a wound was or was not self-inflicted, may refer to the living as well as to the dead. Thus a man may produce wounds upon himself for the purpose of simulating a homicidal assault, which, for various motives, he may allege to have been committed upon him. With the motives for the self-infliction of wounds a medical jurist has no concern, it is of the fact only that he can take cognizance:—from the cases that have yet occurred, it would appear that the object has been to conceal murder, robbery, or some other crime, and to turn away suspicion from the wounded party. One of the most remarkable cases of this kind which have occurred in England was that of Bolam, who was tried for the murder of a man named Millie at the Newcastle Autumn Assizes, 1839.

It is impossible to enter into all the particulars of this singular trial; but it may suffice to state, that the prisoner Bolam was found lying in an apartment, which had been fired by himself or some incendiary, and near him was the body of the deceased, who had evidently been killed by violence,—the skull having been extensively fractured by a poker lying near. The prisoner was, when found, either insensible or he pretended to be so. He stated that he had been suddenly attacked by a man, and knocked down by a blow on the right temple. After attempting to escape, he was again knocked down. He then felt a knife at his throat, but admitted that he did not put up his hands to protect it. His hands were not cut. He said he remembered receiving some blows on his body, but he became insensible, and recollected nothing more. On examining his throat, there was a wound an inch and a half in length on the left side of the neck, a quarter of an inch below the jaw. It had penetrated merely through the true skin, and was of no consequence. A small quantity of blood, which had flowed down on the inside of his cravat, had escaped from this. There were many cuts on his coat at the back and sides, through his waistcoat, shirt and flannel shirt, but there were no corresponding cuts or stabs, nor indeed any mark of injury upon the skin. The question was, whether these wounds had been inflicted by the unknown person who was alleged to have fired the premises and murdered the deceased, or whether the prisoner had inflicted them on himself, in order to divert attention and conceal the crime which he was accused of having committed. No motive for the imputed crime was discovered, and he had borne a very good character; but nevertheless the medical facts relative to the probable self-infliction of the wounds were so strong, that he was convicted of manslaughter.

There can hardly be a medical doubt that the prisoner produced the wounds upon himself. They were superficial, involved no important organs, and bore those characters which wounds only would have that were not produced with a suicidal intention.

Soon after Bolam's case, one somewhat similar occurred in this metropolis. The steward of a club-house was found one morning in bed wounded, and the cash-box of the club was missing. Circumstances led the police to suspect that no one could have broken into the house; but the man himself was considered so trustworthy, that no suspicion was entertained of his having been concerned in the robbery. The surgeon who examined him, found the wounds on his person of a very trivial character; and there was but little doubt, from what subsequently transpired, that he had produced them on himself for the purpose of averting suspicion.

It is not always easy to trace out the motive for the production of these injuries, and when a reasonable motive is not immediately discovered, persons are very apt to be misled and to credit the story. Individuals who have been convicted of thus imputing violence to others, have generally borne a highly respectable character until the occurrence, and this has contributed to disarm suspicion. When a person intending to commit suicide fails in the attempt, he has sometimes, under a sense of shame, attributed the infliction of a wound in his throat to another, but facts of this kind may be without difficulty cleared up by circumstantial evidence.

In respect to imputed wounds, if we except the case of an attempt at suicide, where the injury is commonly severe, they are generally of a superficial character,—consisting of cuts or incisions:—deep stabs are seldom resorted to where the purpose is not suicide but merely to conceal other crimes. Further, these wounds are in front of the person and on the right side or left according to whether the person be right or left-handed. They have also been generally numerous and scattered wide apart. The hands are seldom wounded, although in the resistance to real homicidal attempts, it is these parts which commonly suffer most severely. The injuries are not usually situated over those parts of the body in which wounds are by common repute considered mortal. Contusions or contused wounds are seldom inflicted by a person on himself under these circumstances.

A remarkable case, in reference to this question, occurred in France some years since. I allude to that of M. Tardif (Ann. D'Hyg. 1833, 417). No motive could here be discovered for the self-infliction of wounds, and there was great room for suspicion. Breschet considered that they had been inflicted by another in a homicidal attempt.

CHAPTER XXXIV.

WAS THE WOUND THE DIRECT CAUSE OF DEATH?

It is important for a medical witness to bear in mind that in all cases of wounds criminally inflicted, the cause of death must be certain. No man is ever convicted upon mere medical probability. In general, there is only one real cause of death, although other circumstances may have assisted in bringing about a fatal result. Thus a person cannot die of disease in the bowels, or a stab in the chest at the same time, nor of apoplexy from disease and compression of the spinal marrow at the same instant. Hence it is our duty when several apparent causes for death exist, to determine which was the real cause; and in stating it to the court, to be prepared to offer our reasons for this opinion. In most cases of local injury, when a person dies speedily, there will be no great trouble in settling whether disease or the injury was the cause. A difficulty will, however, commonly exist when a person has recovered from the first effects of a wound, and has subsequently died. Besides, there may be cases in which the cause of death, in spite of the most careful deliberation, will be still obscure; or sometimes it happens that the death of a party appears to be as much dependent on bodily disease as on an injury proved to have been received at the time he was labouring under disease. How is an opinion to be expressed in such a case? The course which I apprehend a medical witness ought to pursue, provided he has duly deliberated on the circumstances before he appears in court, and his mind is equally balanced between the two causes, is to state at once his doubt to the jury without circumlocution, and not allow it to be extracted from him in cross-examination. It is the hesitating to assign a satisfactory cause, or the assigning of many causes for death, that gives such advantage to a prisoner's case, even when the general evidence is entirely against him.

Occasionally many causes of death are assigned by a witness, among which some have a tendency to exculpate and others to inculpate the prisoner in a greater or less degree, and it is left to the jury to select from the number, one upon which to found a verdict. In a case of this kind an acquittal is commonly obtained. Some years since, the following trial took place on the Home circuit.

The prisoner, a female of low character, was charged with manslaughter. The evidence went to show that the deceased was first knocked down by a blow on the head, and while lying on the ground, was severely beaten, the blows being chiefly directed at her head and chest. The deceased died three days after the receipt of the injuries. The medical practitioner, who examined the body, stated that there were the marks of severe contusions externally, while the chief morbid appearance internally, was an inflamed state of the lining membrane of the stomach and upper part of the intestinal canal. He attributed death to this condition of the stomach, bringing on sickness and bilious diarrhea. He admitted that death might have been produced by blows, by the concussion which the body received, or by excitement. He would not undertake to swear that the state of the stomach was occasioned by blows, although he admitted it as possible that blows and stamping on the soft parts, might suffice to produce such appearances. Bilious diarrhea seldom proved mortal, unless there were something to add to it. The judge observed that the cause of death, assigned by the witness, was too remote and speculative to convict the prisoner, and the jury accordingly returned a verdict of acquittal. This case naturally suggests the following question, Why is a medical man summoned on these occasions, if not to inform an uninstructed jury, which, of many causes of death, is the most probable? It is no information to them, but rather an embarrassment, to hear an opinion given that four or five causes operated to produce death, and the medical witness is not prepared to show that one of these is more probable than another. There must undoubtedly be cases where it will be scarcely possible to determine whether death was a consequence of local injury or of co-existing disease, but it is not to be admitted as a medico-legal axiom that this event can take place from and be equally ascribable to four or more distinct causes.

A witness cannot do greater mischief to his own reputation than by assigning many speculative causes for death. The Court will at once infer, either that he is ill-informed in his profession, or that he has taken no pains to estimate in his own mind what was the real cause previous to his appearance at the trial. By preliminary reflection it is very easy for a medical witness to guard against the common occurrence of stating one cause of death to the counsel for the prosecution, and another to the counsel for the prisoner.

A wound may cause death either *directly* or *indirectly*. A wound operates as a direct cause of death when the person dies immediately, or very soon after its infliction; and there is no other cause, internally or externally, to account for death. In wounds which cause death indirectly, it is assumed that the deceased survives for a certain period, and that the wound is followed by inflammation, suppuration, gangrene, tetanus, erysipelas, or some other mortal disease, which is a direct and not an unusual consequence of the injury. Under this head may be also arranged all those cases which prove fatal by reason of surgical operations rendered imperatively necessary for the treatment of the injury,—presuming that these operations have been performed with ordinary skill and care.

We shall for the present consider only the direct causes of death in cases of wounds. These are three in number. 1. Hæmorrhage. 2. Great mechanical injury done to an organ important to life. 3. Shock, or concussion, whereby the functions of one or more vital organs are arrested, sometimes with but very slight injury to the part struck or wounded. From either of these causes a wounded person may die either immediately, or within a very few minutes.

1. HÆMORRHAGE.—Loss of blood operates by producing fatal syncope. A quantity of blood, however, insufficient to cause syncope, may readily destroy life by disturbing the functions of the organ or part into which it is effused. Thus a small quantity poured out in or upon the substance of the brain, may kill by inducing fatal compression;—and again, if in a case of wounded throat it should flow into the trachea, it may cause death by asphyxia, i. e. by stopping the respiratory process. In both of these cases it is obvious that the blood acts mechanically, and with respect to the last, a medical man may, unless circumspection be used, involve himself in a charge of malapraxis. If he allows the wound to remain open, the wounded person may die through hæmorrhage,—if he closes it too soon, he may die through suffocation; and, in either case, the counsel for the prisoner will not fail to take advantage of a plausible objection of this kind.

In wounds of the chest, involving the heart and lungs, death is very frequently due not so much to the actual quantity of blood effused as to the pressure which it produces upon these organs. A few ounces effused in the bag of the pericardium will entirely arrest the action of the heart.

The absolute quantity of blood required to be lost in order to prove fatal must, of course, vary according to numerous circumstances. The young, the aged—those who are labouring under infirmity or disease, will perish sooner from hæmorrhage, than those who are healthy and vigorous. Females, cæteris paribus, are more speedily destroyed by hæmorrhage than males. Young infants are liable to die from hæmorrhage resulting from very slight wounds. An infant has been known to bleed to death from the bite of a single leech. The healthy and vigorous, when their vital powers have been depressed by maltreatment or by brutal violence, will sink under the loss of a comparatively small quantity of blood. (See Watson on Homicide, p. 90.)

A medical jurist must not forget that some individuals have what is termed a hæmorrhagic diathesis, and this condition is often hereditary. The slightest wound or puncture,—the bite of a leech or the extraction of a tooth will be attended with an effusion of blood which cannot be arrested, and which will slowly lead to death by exhaustion. Cases have been frequently recorded in our medical journals, of fatal hæmorrhage following the extraction of teeth, where there had been previously nothing to indicate the probable occurrence of death from so trivial a cause. For a striking instance of this remarkable tendency to hæmorrhage in a family, see Brit. and For. Med. Rev. xvii. 247. Such cases are without difficulty detected :—since a surgeon may always infer from the part injured, and the extent of the injury, whether or not the hæmorrhage is likely to be copious. When a person bleeds to death from what would, under common circumstances, be a simple wound,—the admission of this fact will lessen the responsibility of an accused person.

A sudden loss of blood has a much more serious influence than the same quantity lost slowly. A person may fall into a mortal syncope from a quantity of blood lost in a few seconds, which he would have been able to bear without sinking, had it escaped slowly. This is the reason why the wound of an artery proves so much more rapidly fatal than that of a vein. Death speedily follows the wound of a large artery like the carotid ; but it takes place with equal certainty, although more slowly, from wounds of smaller arteries. In a case where one of the intercostal arteries was wounded by a small shot, hæmorrhage caused death in thirty-eight hours. The hæmorrhage which follows the division of the smaller branches of the external carotid is often sufficient to destroy life unless timely assistance be rendered. A case was tried at the Berkshire Spring Assizes, 1832, in which it was proved that the prisoner had killed his wife by stabbing her in the leg ;—the anterior tibial artery was divided, and she died from hæmorrhage half an hour afterwards. Wounds of arteries, even smaller than these, might in some subjects prove fatal if no assistance were at hand. Mr. Watson mentions a case where the internal mammary artery on the left side was divided by a stab in the chest. The woman died on the ninth day, and four pounds of blood were found effused on that side. In another case where an intercostal artery was divided six pounds of blood were effused. (Op. cit. 101.) In both of these cases, as in most wounds of the chest, the blood not only affected the system by its loss, but by its compressing the lungs and impeding respiration. Wounds of large veins, such as the jugular, may speedily destroy life. If a wound be in a very vascular part, although no vessel of any importance be divided, the person may speedily die from hæmorrhage.

It is difficult to say what quantity of blood should be lost, in order that a wound may prove fatal by hæmorrhage. The whole quantity contained in the body is calculated at about one-fifth of its weight, i. e. about thirty pounds:—of this one-fourth is considered to be arterial and the remaining three-fourths venous blood. According to Mr. Watson, the loss of from five to eight pounds is sufficient to prove fatal in adults:—but while this may be near the truth, many persons will die from a much less quantity; the rapidity with which the effusion takes place having considerable influence. It has been found, by experiment, that dogs cannot bear the loss of more blood than is equivalent to one-twelfth part of the weight of the body.

It must not be supposed that all the blood met with round a wounded body, was actually effused during life. As soon as the heart's action ceases, the arteries pour out no more; but the blood, so long as it remains liquid and the warmth of the body is retained, continues to drain from the divided veins and smaller vessels. The quantity thus lost, however, is not very considerable, unless the veins be large. A question relative to the degree of this post-mortem hæmorrhage has very frequently been put in a court of law.

Hæmorrhage may prove fatal, although the blood does not escape from the body. In incised wounds, the flow is commonly abundant; but in punctured and gun-shot wounds, the effusion may take place internally and rapidly cause death. In severe contusions or contused wounds, the effusion may go on to an extent to prove fatal, either in the cavities of the body or throughout the cellular membrane. Many pounds may in this way become slowly or rapidly extravasated.

The means of ascertaining, whether a person has died from hæmorrhage, are these. Unless the wound be situated in a very vascular part, we shall find the vessel or vessels from which the blood has issued, divided,—the neighbouring vessels empty and the body more or less pallid; although this last condition is of course liable to be met with in certain cases of disease, as also under copious venesection,—points easily determined by an examination. The blood will also be found clotted or coagulated on those surfaces on which it has fallen. If, with these signs, there is an absence of disease, likely to prove rapidly fatal; and no other probable cause of death be apparent, it may be fairly referred to hæmorrhage. This opinion may be materially modified by the fact of the body not being seen on the spot where the fatal wound was actually inflicted,—by the wound having been sponged,—the blood removed by washing, and all traces of hæmorrhage destroyed. Under these circumstances, the case must be in a great measure made out by presumptive proof; and here a medical witness may have a new duty thrown upon him, namely, that of examining articles of dress or furniture for marks or stains of blood.

Hæmorrhage may in some instances take place from a wound in a dead body after the vital heat has entirely disappeared,—a fact which in former times, gave rise to the most superstitious notions, and which even in the present day, often induces a coroner's jury wrongly to suspect that homicide has been committed. In order to explain this and some other vital phenomena connected with the dead body, it is necessary to refer to those spontaneous changes in the solids and liquids which commence soon after death. When a person has died suddenly from violence or disease, it often happens that within a short period, the whole of the cavities, including the veins, arteries and cellular tissue, become distended from the gases extricated in incipient putrefaction. These gases, when they collect in the abdomen, push back the diaphragm, in consequence of which, mucus in the state of froth often issues from the mouth and nostrils:—the face becomes swollen, the eyes bright and prominent, owing to the blood being forced back to the head and neck. From the same cause, it sometimes happens that the contents of the stomach are actually discharged, escaping into the trachea or externally by the mouth. These gases appear also to be formed within the heart and blood-vessels, a circumstance which leads to the effusion of blood from a wound made into a vessel before death, long after life has ceased. If an attempt has been made to bleed a person before death, and the operator has neglected to secure the opening in the vein, a large quantity of blood will sometimes thus escape, giving to those who are unacquainted with the cause, the impression that the deceased had again come to life, but had died from the bleeding. An accident of this kind gave rise to considerable discussion on the occasion of an inquest held at Oldham, on the body of one John Lees, killed in the Manchester riots in 1819, as also in the case of the Crown Prince of Sweden, who was suspected to have been poisoned, (anté, p. 35.) A similar flow of blood may take place from any large incised wound involving a vein made recently before death. This post-mortem hæmorrhage is facilitated by pressure; and hence probably arose the ancient test of the guilt of an accused party,—namely, the touch of a murderer.

Chemical examination of blood stains.—It might appear at first sight a very easy matter to say whether certain suspected spots or stains on articles of clothing, furniture or weapons, were or were not due to blood: but in practice, great difficulty is often experienced in forming an opinion. If the stains be recent, most persons might be competent to form an opinion; but the physical characters of blood are soon changed even when the stuff is white and otherwise favourable to an examination. Again, when the stains, whether recent or of old standing, are upon dark-dyed woollen stuffs, as blue or black cloth, or when they appear in the form of spots or thin films on a rusty weapon, no one but a professional man should be allowed to give an opinion. It is, however, by no means unusual to find magistrates and coroners, questioning policemen respecting the nature of suspected stains,—a practice obviously unjust to the accused and fraught with considerable danger

There is no direct chemical process by which blood can be identified, but we presumptively establish its nature by determining the presence and properties of the red colouring matter or hæmatosine. These properties are as follows:—

1. The colouring matter of blood readily combines with distilled water, forming, if recent, a rich red solution. 2. The red colour of this solution is neither turned of a crimson or a green colour by a solution of ammonia: if the ammonia be very concentrated, the red liquid acquires a brownish tint. 3. The red liquid when boiled is coagulated,—the red colour is entirely destroyed and a muddy brown flocculent precipitate is formed;—the quantity of which will depend on the quantity of colouring matter and albumen present. 4. The coagulum produced by boiling, when collected on a filter and dried, forms a black resinous-looking mass quite insoluble in water, but readily soluble in boiling caustic potash, and the alkaline solution thus produced, is, when concentrated, of a red colour by transmitted, and of a green colour by reflected light. 5. To the above tests some have united the action of strong nitric acid, which coagulates the red colouring matter, turning it of a dirty brown hue.

It will now be proper to mention the action of these tests upon other red colouring matters, extracted from the animal or vegetable kingdom. Some of these are turned green by ammonia, as the colouring matter of the rose,—others crimson, as the red colouring matter of cochineal and of lac. None of these red colours are coagulated or destroyed by boiling. In these respects, therefore, the colouring matter of the blood is eminently distinguished from them. M. Raspail has objected that a mixture of madder and albumen possesses all the characters assigned to blood. Having for some years past performed numerous experiments on this subject, by making artificial mixtures of human serum or animal albumen, with the red colouring matters of cochineal, lac, and madder, neutralizing the effects of the alkali in the serum by the addition of a small quantity of acetic acid, I feel justified in stating that in no respects except in regard to colour, can such mixtures be confounded with blood. The objection is therefore more theoretical than practical. These red liquids may easily deceive those who trust to a red colour alone; and herein we see the absolute necessity for placing the investigation of such subjects in the hands of professional persons only.

It may be observed of all such artificial mixtures, that by ammonia they are changed to a crimson or green colour, and that under no circumstances is the red colour destroyed by boiling the solution in water. The albumen or serum coagulates, but still retains the red colouring matter locked up within the coagulum. In the case of blood, the effect of heat is widely different.

Stains of blood on linen and other stuffs.—Supposing the stuff to be white or nearly colourless, the spot is of a deep red colour if recent:—but it becomes of a reddish brown, or of a deep brown, by keeping. The change of colour to a reddish brown I have found to take place in warm weather in less than twenty-four hours. After a period of five or six days it is scarcely possible to determine the date of the stain even conjecturally. In a large stain of blood on linen no change took place during a period of three years:—it had a brown colour at the end of six weeks, which it retained for the long period mentioned. Indeed it is extremely difficult in any case after the lapse of a week, to give an opinion as to the actual date of a stain. Upon coloured stuffs it is of course, impossible to trace these physical changes in stains of blood. In order to determine whether the stain be due to blood, we cut a slip of the stained part of the linen and suspend it by a thread in a tube containing a small quantity of distilled water. After a few minutes, or a few seconds if the stain be recent, a red liquid will be seen falling in fine dark threads and collecting at the bottom of the test-tube, giving a red colour to the lower stratum of water if the stain be recent; and a dark red brown colour if of old standing. Several slips of the stuff may be thus successively treated until a liquid, sufficiently deep in colour for testing, is procured. If the quantity of coloured liquid thus obtained be small, the supernatant clear water may be poured off. The liquid may then be tried by weak ammonia, and by the application of heat. If ammonia produce any effect upon the solution of blood, it is simply to brighten it,—this alkali never changes the red colour to green or crimson. When the stain is of old standing,—the solution in water does not present the bright red colour of blood, and the action of ammonia may be obscure, although it never gives to the liquid a green or crimson tint: but the action of heat is always certain and effectual; and if the coloured solution be in such small quantity that there is no coagulum obtained by heat, it is impossible to give a decided opinion that the stain is due to blood. In May, 1838, a piece of linen was examined on which there were two faint spots of blood, each about one quarter of an inch in diameter. A reddish coloured liquid was procured, but no coagulum could be obtained on boiling. When the quantity of blood effused is moderately large, it may be easily detected by the above process—even after the lapse of a great length of time. I have thus detected the blood of the human subject and of the bullock on cotton, linen and flannel, after the lapse of three years. If the stuff be dyed we should proceed to examine it in the same way. Thus then in testing for blood we rely upon, 1, the ready solubility of the hæmatosine in water; 2, the negative action of ammonia; and 3, the positive effect of heat in entirely coagulating and destroying the red colouring matter.

It may, however, be objected, that red stains closely resembling blood are occasionally found on linen and other stuffs. It is to be remarked of all such stains, that they are either entirely insoluble in water or they are soluble. If insoluble they cannot by any possibility be mistaken for blood. It is very true, that if the linen which is stained with blood, be heated to a high temperature, the colouring matter may be no longer soluble in water;—but it is not probable that medical evidence will be thus defeated, except by those who have made a profound study of the difficulties of medical jurisprudence. In the case of a body found wounded and burnt we may allow for such a change.

Among what may be classed as *insoluble* stains, are, 1, certain *Red dyes*, as madder for instance, which when fixed by a mordant, is not readily affected by ammonia. 2. *Iron moulds*—these are of a reddish-brown colour, sometimes of a bright red,—they are quite insoluble in water, but are easily dissolved by diluted muriatic acid, and on adding ferrocyanate of potash to the muriatic solution, the presence of iron will be at once apparent. Care should be taken that the muriatic acid used for this purpose contains no iron. Some years since, a man was found drowned in the Seine, at Paris, under suspicious circumstances. The body had evidently lain a long time in the water. On examining the shirt of the deceased, a number of red-brown stains were observed upon the collar and body, resulting, as it was supposed, from blood which had become changed by time. On a chemical examination, however, they were found to be iron-moulds produced by the corrosion of a steel-chain which the deceased had worn round his neck! 3. *Red paint.*—Stains made with red paint have been mistaken for blood. In March, 1840, a person was murdered at Islington. An individual was arrested on suspicion, and in his possession was found a sack having upon it many red stains, which were supposed to be dried and coagulated blood. They were examined by Professor Graham, who found that they were caused by red paint, containing peroxide of iron, and the sack was proved to have been worn as an apron by a youth who was an apprentice to a paper stainer. It had been sent to the accused party a few days before, as a wrapper to a parcel. The accused was immediately discharged. Stains of this kind would be known by digesting them in diluted muriatic acid, and applying to the solution the tests for iron. Like those produced by iron-moulds, they are perfectly insoluble in water, and therefore cannot be confounded with blood-stains.

Among the *soluble* stains simulating blood are the spots produced by the juices of the mulberry, currant, and other red fruits. These are commonly recognized by dropping on them a solution of ammonia, when the spot is turned either of a green or crimson colour. A spot of blood thus treated undergoes no change. Further, if a piece of the stained stuff be suspended in water, the coloured liquid, if any be obtained, is easily known from blood, by its acquiring a green or crimson tint on the addition of ammonia, and, by the red colour not being coagulated or destroyed when the liquid is boiled. In some red stuffs, the dye is often so bad, that water will dissolve out a portion of the colour; but in this case the action of ammonia and heat will serve readily to distinguish the stains from blood. If minute spots be scattered on articles of furniture, these may be examined by cutting out the stained portions and treating them in the way just mentioned. It is said that blood-stains, when minute and scattered, are more readily recognized and identified by the light of a candle than in the light of day. I do not know that much reliance can be placed on this statement. The brown stains appear to acquire a more red tint.

It is not unfrequent that an attempt is made by a murderer to wash out blood-stains, so that the colour is lost and no chemical evidence can be obtained. There is a common notion that certain chemical agents will remove or destroy these stains; but that is not the case,—the colour may be altered, but it is not discharged or bleached. Chlorine, the most powerful decolorizing agent, turns the colouring matter of blood of a green-brown colour. I have found that nothing removes a blood-stain so effectually as simple maceration in cold water, although the process is sometimes slow. On an important trial for murder, at the Shrewsbury Lent Assizes, 1841, (the Queen against Misters,) this question as to the power of certain re-agents in discharging stains of blood, was raised. Alum was traced to the possession of the prisoner; it was found dissolved in a vessel in his bed-room, and it was supposed that he had removed blood-stains from his shirt by the use of this salt. Two medical witnesses deposed that they had made experiments and had found that alum would take the stains of blood out of linen:—according to one, sooner than soap and water. The results of my experiments do not correspond with these. I have not found that alum extracts stains of blood so readily as common water, and when alum is added to a solution of hæmatosine in water, so far from the colour being discharged, it is slowly converted to a deep greenish brown liquid. In one experiment, a slip of linen having a deep stain of dried blood upon it of old standing, was left in a solution of alum for twenty-four hours, but not a particle of the red colouring matter had been extracted. The prisoner's guilt did not rest on this point alone,—that was made sufficiently evident from other circumstances: but there have been few cases tried in England where the facts connected with analysis of blood-stains were so closely examined as in this.

In a case to be presently related, I was consulted as to whether the alkali contained in soap would alter or remove blood-stains. The effect of potash, soda, or their carbonates, is to change the red colour of blood to a deep greenish brown, like many other reagents, but they do not exert on it any discharging or bleaching power. Combined with friction, blood-stains may be easily effaced by any cold alkaline or soapy liquid.

Stains of blood on weapons.—When recent, and on a polished instrument, these are easily recognized, but when of old standing, or on a rusty piece of metal, it is a matter of some difficulty to distinguish them from the stains produced by rust or other causes. If the stain of blood be large, a portion will readily peel off on drying. This may be placed in a watch-glass of distilled water filtered, to separate any oxide of iron, and then tested. If the water do not acquire a red or red-brown colour, the stain is not due to blood. Sometimes on a dagger or knife, the stain appears in the form of a thin yellowish film, and is so superficial that it cannot be mechanically detached. We should then pour a stratum of water on a piece of plate-glass, and lay the stained part of the weapon upon the surface. The water slowly dissolves any portion of the colouring matter of blood, and this may be examined in the way recommended. If the weapon have been exposed to heat, this mode of testing will fail.

There is often a remarkable resemblance to the stains of blood produced by the oxide or certain vegetable salts of iron. If the juice of lemon or orange be spread upon a steel blade, and remain exposed to air for a few days, the resemblance to blood produced by the formation of citrate of Iron is so strong, that I have known well informed surgeons to be deceived:—they have pronounced the spurious stain to be blood, while the real blood-stain on a similar weapon was pronounced to be artificial. This difficulty of distinguishing such stains by the eye, is well illustrated by a case which occurred in Paris a few years since. A man was accused of having murdered his uncle, to whose property he was heir. A knife was found in his possession, having upon it dark-coloured stains, pronounced by those who saw them to be stains of blood. M. Barruel and another medical jurist were required to determine the nature of these stains, and the examination was made before a magistrate in the presence of the accused. They were clearly proved by these and other experiments, to be spots produced by the citrate of iron. It appeared on inquiry, that the knife had been used by some person a short time previously, for the purpose of cutting a lemon; and not having been wiped before it was put aside, a simple chemical action had gone on between the acid and the metal, which had given rise to the appearance. This case certainly shows, that physical characters alone cannot be trusted to in the examination of these suspicious stains. Stains of the citrate of iron may be thus known:

The substance is soluble in water, forming, when filtered, a yellowish brown solution, totally different from the red colour of blood under the same circumstances. The solution undergoes no change on the addition of ammonia. It is entirely unchanged at a boiling temperature: and it is at once identified as a salt of iron, by giving a blue colour with the ferrocyanate and a deep red with sulphocyanate of potash. I have also observed, that spots of the citrate of iron on knives, for they are not found on other weapons, are generally soft and deliquescent, while those of blood are commonly dry and brittle.

It might be supposed to be a very simple matter to distinguish by sight, a stain of blood on a weapon from a mark produced by iron rust; but this is not the case. When suspicion exists, it is astonishing how readily mistakes are made; and marks are pronounced to be due to blood, which, under other circumstances, would have passed unnoticed. One source of difficulty is this: the iron rust is often mixed up with articles of food on an old knife, or even with blood itself.

We must here pursue the same mode of examination, as if the stain were of blood; we macerate the weapon or a portion of the coloured deposit in a small quantity of distilled water, and filter the liquid. If the stain be due to iron-rust, this is separated by filtration, and the liquid comes through colourless. The absence of blood is thereby clearly demonstrated; for I need not here consider the objection, that the weapon may have been exposed to heat, and thus have rendered the blood-stain insoluble in water. If we now digest the brown undissolved residue left on the filter, in diluted muriatic acid free from iron, we shall obtain a yellowish solution, which will give the proper reactions for iron, with the ferrocynnate and sulphocyanate of potash. It has been recommended, to put muriatic acid on the stain as it exists on the weapon, and then to test the liquid, as the red spot of rust is soon removed by the acid; but the objection to this is, that a spot containing blood, may be thereby pronounced to be one of rust only, since muriatic acid in all cases, dissolves a portion of the iron, and the solution would therefore give the characters of an iron stain with the tests. In all old blood-stains where the weapon is rusty, blood and oxide of iron are mixed. These may be easily separated by digesting the compound in water and filtering the blood only is dissolved, while the rust is left on the filter.

The following case was referred to me for examination a few years since. A man was suspected of murder, and some stains existed on his shirt, which were supposed to have been produced by blood. Around the collar and upper part of the shirt, there was a large and somewhat deep pinkish-red stain, in some respects resembling washed blood. This I considered as a very unusual situation for blood to be found sprinkled; and upon trying the stained linen by the processes mentioned, the colour entirely resisted separation by water, and was turned of a slight crimson tint by ammonia. The stain was thus shown not to be due to blood. On inquiry, it was ascertained, that the man had worn round his neck, a common red handkerchief during a wet night, and while taking violent exercise. The stain was thus accounted for. There were, however, some other marks on the shirt which required examination, as there was a very strong suspicion against this man. These were on the sleeves, at those parts which would be likely to receive stains of blood if they had been rolled or turned up at the wrists; and it was clearly ascertained, that the murderer in this case, had washed his hands, using a quantity of yellow soap. These stains were of a brownish colour, without any shade of red; they were faint in parts and diffused, conveying the impression that an attempt had been made to wash them out. So far as external characters were concerned, it was quite impossible to say whether they had been produced by blood or not. On examining those parts of the shirt, corresponding to the axillæ, stains precisely similar were there seen, evidently resulting from cutaneous perspiration; since the suspicion of blood being poured out on this part of the shirt under the circumstances, could not be entertained.

Slips of linen from the stained portions of the sleeves were digested in water. In twenty-four hours, the stains were entirely removed; and the lower stratum of water in each tube, had acquired a straw-yellow colour. There was not the least shade of a red or brown tint; and the solution was wholly unlike that produced by blood under any circumstances. The solution was unaffected by ammonia, and a heat of 212°; but it gave a faint opalescence on the addition of nitric acid. These results not only indicated the absence of blood, but showed that the stains were due to cutaneous perspiration, acting on a dirty skin, and through a dirty dress. The stains n the part corresponding to the axillæ could not be ascribed to blood; and rom the similarity in physical and chemical properties, it was impossible to attribute those on the sleeves to any sanguineous effusion. It so happened, however, hat a large pocket-knife, with numerous dark-red stains on the blade and between the layers of the handle, was found upon this man, and this was also sent or examination Several persons who saw the knife, pronounced a strong opinion that the marks were due to blood. The stains were made up of some soft viscid matter which gave out ammonia when heated, and left a residue of peroxide of iron. On digesting the matter in water, no portion was dissolved; and it was, therefore, evident that they were due not to blood, but o a mixture of some animal matter, probably food, with iron-rust.

These results were somewhat in the man's favour, at least they removed what was considered to be a strong circumstantial proof of his guilt. He was subsequently tried for the murder, and acquitted on an alibi, established by he evidence for the prosecution.

From the foregoing remarks, we may justly infer, that the analysis of uspected spots or stains on weapons and clothing, is by no means a trivial r unimportant duty. If we cannot always obtain from these experiments ood affirmative evidence, they often furnish good negative proofs, and thus end to remove unjust suspicions against accused parties. There is one cirumstance, however, of which a medical jurist is entitled to complain, amely, that a magistrate or coroner should ever receive evidence on matters f this kind from non-professional persons, or that they should ever trust to hysical characters only. On the occasion of the murder of Eliza Grimood, in June 1838, committed as it was under circumstances of the greatst mystery, and the perpetrator of which has never been discovered, the nalysis of suspected marks resembling blood, became rather an important art of the inquiry, but it was most improperly conducted. The finger-plates f the door of the room, in which the murder was perpetrated, presented some dark stains, supposed to have been produced by the bloody hand of the murderer in the act of escaping. The only test to which these were submitted, was, that the magistrate before whom the case was heard, tried to rub off some of the stains with a piece of blotting paper, but did not succeed; and he expressed his opinion, that if they were blood-stains they had been wiped! It is easy to perceive, to what results superficial examinations of this kind may lead.

When marks of blood undeniably exist on the dress of an accused person, it is by no means unusual to find these marks referred to his baving been engaged in killing a pig or a sheep, or handling fish or dead game. Of course, every allowance must be made for a statement like this, which can only be proved or disproved by circumstances. A question here arises, whether we possess any chemical means of distinguishing the blood of a human being from that of an animal, as well as the blood of a man from that of a woman.

Some French medical jurists state, that by mixing fresh blood with one-third or one-half of its bulk of strong sulphuric acid, and agitating the mixture with a glass rod, a peculiar odour is evolved, which differs in the blood of man and animals, and also in the blood of the two sexes. This odour, it is said, resembles that of the cutaneous exhalation of the animal, the blood of which is made the subject of experiment. They have hereby pretended to determine, whether any given specimen of blood had belonged to a man, a woman, a horse, sheep, or fish. Others pretend that they have been able to identify the blood of frogs and fleas! (See Devergie, Med. Leg. ii. 907.)

Now it is certain, that an excess of strong sulphuric acid, does give rise to a particular odour in blood, probably owing to its decomposing some of the animal principles of that liquid; it is also possible that some persons may discover a difference in the odour, if not according to the sex, at least according to the animal, but even this point is far from being established; and if it were admitted, there is probably not one individual among a thousand, whose sense of smelling would be so acute as to allow him to state with undeniable certainty, from what animal the unknown blood had really been taken. Any evidence short of this would not be received in an English court of law; for it is considered better not to decide at all, than to decide on principles which are exposed to unavoidable fallacy. Besides, it must be remembered, that in general the operator has not before him the blood, but merely a very diluted solution of the colouring matter mixed with a small quantity of serum.

II. GREAT MECHANICAL INJURY DONE TO AN ORGAN IMPORTANT TO LIFE.—We have instances of this becoming a direct cause of death in the crushing of the heart, lungs or brain, by any heavy body passing over or falling on the cavities. This severe mechanical injury is sometimes accompanied by a considerable effusion of blood, so that the person really dies from hæmorrhage; but in other instances the quantity of blood lost is inconsiderable, and the fatal effect may be referred to shock.

III. SHOCK.—This is a direct cause of death under the infliction of external violence; and in this case life is destroyed without the injury being to all appearance sufficient to account for so speedily fatal a result. There is no medical doubt that a person may die from what is termed shock, without there being any marks of severe injury discoverable after death. Examples of this mode of death we have in accidents from lightning, or from severe burns or scalds, in which the local injury is often far from sufficient to explain the rapidly mortal consequences. As instances of this form of death from violence, may be cited those cases in which a person has been suddenly killed by a blow on the epigastrium, which is supposed to operate by producing a fatal impression on the cardiac plexus. Whether this be or be not the true explanation, the fact itself is undisputed; it is certain that a person may die from so simple a cause without there being any appearance externally or internally to account for death. On the skin, there may be some marks of abrasion or ecchymosis, but as it has been elsewhere stated, these are neither constant nor necessary accompaniments of a blow. Convictions for manslaughter have taken place where death has been produced under these circumstances. Concussion of the brain, unattended by mechanical lesion, is another example of this kind of death. A man receives a severe blow on the head; he falls dead on the spot, or becomes senseless and dies in a few hours. On an inspection, there may be merely the mark of a bruise on the scalp; in the brain, there may be no rupture of vessels or laceration of structure, and all the organs of the body are healthy. Thus, then, there is no sign of a mortal injury; and there is apparently no cause to account for death. This can only be referred to the shock or violent impression which the nervous system has sustained from the blow; and which the vital powers were wholly unable to counteract or resist.

A medical witness must give his evidence with caution in such cases; since it is the custom to rely in the defence upon the absence of any *mortal* wound to account for death,—a principle which if once unrestrictedly admitted as correct, would leave a large number of deaths undoubtedly occurring from violence, wholly unexplained.

A trial took place at the Liverpool Autumn Assizes, 1837, wherein several persons were charged with the manslaughter of the deceased by kicking him behind the right ear. The medical witness deposed that there was in this spot the mark of a severe contusion, but there was no injury whatever to the brain, and the body was otherwise healthy. He very properly ascribed death to the violent shock given to the nervous system, and the court admitted that the cause of death was satisfactorily made out. The party who inflicted the wound was convicted.

There is another form of shock which is of some importance in medical jurisprudence. A person may have received many injuries, as by blows or stripes, not one of which, taken alone, could, in medical language be termed mortal; and yet he may die directly from the effects of the violence either on the spot or very soon afterwards. Death is commonly referred to exhaustion, but this is only another mode of expression; the exhaustion is itself dependent on a fatal influence or impression produced on the nervous system. A prize-fighter after having, during many rounds, sustained numerous blows on the body, may either at or after the fight, sink and die exhausted. His body may present marks of bruises, or even lacerated wounds, but there may be no internal changes to account for death. In common language, there is not a single injury which can be termed mortal, and yet supposing him to have had good health previously to the fight, and that all marks of disease indicative of sudden death are absent, it is impossible to do otherwise than refer his death to the direct effect of the violence. A case of a somewhat similar kind, we have in the military punishment of flagellation, which is occasionally followed by death. In Russia, this is the common mode of executing a criminal, and in this case a stout hard leathern thong is used; death is the almost certain result of a number of stripes. In short, it is a well ascertained medical fact, that a multiplicity of injuries, each comparatively slight, are assuredly as capable of operating fatally as any single wound, whereby some organ important to life is directly affected. Age, sex, constitution, and the previous state of health or disease, may accelerate or retard the fatal consequences.

On a trial for murder, which took place in Germany a few years since, it was proved that the deceased had been attacked with sticks, and that he had been afterwards flogged on the back with willow-switches. He died in about an hour. On inspection, there was no mortal wound nor any lesion to a vital organ; there were simply the marks of lacerations and bruises on the skin, apparently not sufficient to account for death, but this was nevertheless very properly referred to the violence. (Henke Zeitschrift der S. A. 1836.)

From the foregoing considerations, it is obviously absurd to expect, that in every case of death from violence or maltreatment, there must be some specific and well-defined mortal lesion to account for that event. When the circumstances accompanying death are unknown, a medical opinion should always be expressed with caution; but if we are informed, that the deceased was in ordinary health and vigour previous to the infliction of the violence, and there is no morbid cause to account for his sudden illness and death, there is no reason why we should hesitate in referring death to the effects of a multiplicity of injuries. Among non-professional persons a strong prejudice exists that no person can die from violence unless there be some distinct *mortal* injury actually inflicted on his person. By this we are to understand a visible mechanical injury to some organ or blood-vessel important to life; but this is obviously a very erroneous notion, since death may take place from the disturbance of the functions of an organ without this being necessarily accompanied by a perceptible alteration of structure. The prevalence of this popular error, often leads to a severe cross-examination of medical witnesses. Among the questions put, we sometimes find the following.

Would you have said from the wounds or bruises *alone,* that they were likely to have occasioned death? Now in answer to this, it may be observed, that we cannot always judge of the probability of death ensuing from the appearance of external violence alone. But because these appearances were slight, it would be wrong to infer in every case that they were not sufficient to cause death. A man may die from a blow on the epigastrium, and how can this fact be determined by an examination of the body? Then it may be inquired:— Were the wounds or bruises mortal? In the vulgar sense of the word, i. e., by producing severe hæmorrhage or a destruction of parts they might not be so; but in a professsonal view, they may have acted mortally by producing a shock to the nervous system. Or it may be inquired, which of the several wounds or bruises found on the body of the deceased, was mortal? The answer to which may be: Not one individually, but all contributed to occasion death by exhaustion.

It must likewise be remembered, that in all cases where a person has sustained a number of injuries, the loss of a much smaller quantity of blood than in other instances, will suffice to destroy life.

It is sometimes a very difficult question to decide on the degree of mortality of wounds, and on the share which they have had in causing death. By a wound being of itself mortal, we are to understand, that it is capable of causing death directly or indirectly, in spite of the best medical assistance. It is presumed that the body is healthy, and that no cause has intervened to bring about or even accelerate a fatal result. The circumstance of a person labouring under disease when wounded in a vital part, will not, of course, throw any doubt upon the fact of such a wound being necessarily mortal, and of its having caused death. If there should be more wounds than one, it is easy to determine from the nature of the parts involved, which was likely to have led to a fatal result.

In order to determine whether or not a wound was mortal on medical grounds, we may propose to ourselves this question: Would the deceased have been likely to die at the same time and under the same circumstances, had he not received the wound? There can be no general rule for determining the mortal nature of wounds. Each case must be judged of by the circumstances which attend it. In some parts of the Continent, the law requires that a medical witness should draw a distinction between a wound which is absolutely and one which is conditionally mortal. An absolutely mortal wound is defined to be that where the best medical assistance being at hand, being sent for or actually rendered, the fatal event could not be averted. Wounds of the heart, aorta, and internal carotid, are of this nature. A conditionally mortal wound is one, where, had medical assistance been at hand, been sent for or timely rendered, the patient would, in all probability, have recovered. Wounds of the brachial, radial, and ulnar arteries, may be taken as instances. The responsibility of the assailant is made to vary, according to which of these classes, the wound may be referred by the medical witnesses, and, as it is easy to suppose, there is seldom any agreement on the subject. Our criminal law is entirely free from such subtleties. The effect of the wound and the intent with which it was inflicted, are looked to; its anatomical relations, which must depend on pure accident, are never interpreted in the prisoner's favour. Some extenuation is generally admitted when a wound proves mortal through an indirect cause, as inflammation or fever, and medical advice was obtainable, but not obtained until every hope of recovery had disappeared. Even here it ought to be shown, that it was within the power of the wounded person to obtain medical assistance, or such a defence would not be admissible. These nice questions relative to the shades of responsibility, occasionally arise in those cases where a man has been wounded at sea on board of a ship in which there is no surgeon.

CHAPTER XXXV.

DEATH MAY FOLLOW A WOUND, BUT NOT BE CAUSED BY IT.

This event is by no means uncommon, and, as in the minds of non-professional persons, death may appear to be a direct result of the injury, the case can only be cleared up by the assistance of a medical practitioner. In several instances of attempted suicide of recent occurrence, such a coincidence has been witnessed. A man has inflicted a severe wound on himself while labouring under disease; or some morbid change, tending to destroy life, has occurred subsequently to the infliction of a wound,—death has followed; but a surgeon, by careful examination of the body, has been able to refer death to the proper cause. The importance of an accurate discrimination in a case where a wound or personal injuries have been caused by another, must be obvious on the least reflection; a hasty opinion may involve an accused party in a charge of manslaughter; and, although a barrister might be able to show on the trial, that death was probably attributable, not to the wound, but to co-existing disease, yet it must be remembered, that the evidence of a surgeon before a coroner, in remote parts of this country, may be the means of causing the accused to remain incarcerated for a period of five, six, or seven months previous to the trial. This is in itself a punishment, independently of the loss of character to which an accused party must be, in the mean time, exposed.

In September, 1832, an inquest was held on the body of a man who, it was supposed, had died from a wound in the throat, inflicted by himself while labouring under delirium from scarlet fever. On an examination of the body, it was found that but little blood had been lost, and none of the important vessels of the neck were injured. The jury and the friends of the deceased were prepared to hear that his death was caused by the wound; but they were undeceived by the surgeon, who attributed it to the effects of the disease under which he was labouring, adding, that there was every probability that he would have died at the same time, and under the same circumstances, if he had not made the attempt on his life:—a verdict was returned accordingly.

In the following case, a gentleman attempted to commit suicide, by cutting his throat with a pen-knife. He died in about three weeks afterwards, and an inquest was held on the body. From the medical evidence it appeared that the wound was situated on the right side of the neck,—it was four inches in depth, and one inch in length, and involved some of the branches of the subclavian artery. The case went on favourably, but secondary hæmorrhage occurred twice, in consequence of the deceased having violently torn away the dressings. After lying for about three weeks with a fair prospect of recovery, the deceased died suddenly,—a circumstance which led his medical attendants to conclude that some internal disease must have coexisted, although it was the general opinion that the wound had caused death. The body was carefully inspected, and a large abscess occupying one of the hemispheres of the brain, was discovered, with an effusion of water between the membranes. These appearances, coupled with the symptoms immediately preceding, satisfactorily accounted for the fatal result. The medical witnesses accordingly deposed at the inquest, that death was occasioned by the abscess; and that this had no connection whatever in its origin with the wound. They stated that the abscess had probably been forming before the infliction of the wound, and the individual must have died, whether the wound had been inflicted or not. Indeed, the loss of blood would, in their opinion, have tended to stay the activity of the disease, and probably to prolong life.

If we suppose that the wound in this case had been inflicted by another, on provocation, and that the examination of the body had fallen under the hands of a less careful practitioner, who might have neglected to examine the head, the accused party would have been charged with manslaughter, and sent to trial. Here again the same witnesses being examined, and the prisoner's case remaining undefended, the evidence might have appeared sufficient to justify a conviction. No case can more strongly show the responsibility which may be attached to the duties of a witness. The punishment or acquittal of an innocent person, would depend on his medical skill; for we cannot suppose, either that a barrister or a coroner, could always succeed in exposing an error of a nature so exclusively professional. This is a case which also teaches us the importance of constantly adhering to a principle of duty, already recommended,—namely, to examine the whole of the body in suspected death from local injuries. Supposing that in either of these cases, the life of the deceased had been insured—the policy would have been apparently vitiated; and the truth could only have been ascertained by medical evidence. It is not enough to rest contented in any case with an apparent cause of death.

In the next case certain parties were improperly committed on a charge of manslaughter, by a coroner, in spite of the medical evidence, and were acquitted on the trial in consequence of it. The prisoners had been drinking and quarrelling with the deceased on the evening previous to her death, and blows were exchanged. The deceased returned home, was taken violently ill in the course of the night, and expired at seven the next morning. The body was carefully examined by ten medical practitioners, some of whom had seen and attended the deceased during her illness. They all deposed that she had died of malignant cholera, which was then very prevalent, and not from the effects of the alleged violence. In opposition to this evidence, the jury, under the instructions of the coroner, returned a verdict of manslaughter; and although the bill, when presented, was ignored, yet the prosecution was persisted in, solely on the coroner's warrant. After the general evidence had been gone into on the trial, and the medical witnesses had again stated their opinions, the judge interfered and recommended that the prosecution should not be persevered in, against the evidence of the medical men. The counsel for the prosecution, however, dissented from this opinion, and was about proceeding to call other witnesses, when the jury returned a verdict of not guilty.

This case will show that the assistance of medical men is sometimes necessary upon trials, to obviate the effects of errors committed by parties invested with judicial authority, but whose want of proper information on subjects of a professional nature, often incapacitates them for the performance of their duties. A charge of manslaughter cannot be sustained against a prisoner, unless the death be so immediately and obviously occasioned by the violence inflicted by the prisoner, as to exclude all doubt on the subject; and, observes Starkie, "the connection between the act of the prisoner and the death of the deceased, must be proved by means of the judgment of persons of professional skill and experience, who have had an opportunity of forming an opinion upon the subject, or who are enabled to form an opinion from the circumstances of the case, as detailed by others." Here ten medical witnesses unanimously deposed that death did not result from violence, but evidently from a disease, the symptoms and progress of which could not be readily mistaken. There was no difference of opinion. Nevertheless, the prisoner was committed for a crime, to establish which, on the trial, the whole of these witnesses must have recanted their opinions, and sworn to the very reverse of their depositions at the inquest! The counsel for the prosecution admitted that the deceased had died of cholera, but he stated that he was prepared to show the jury, that the violence sustained by the deceased, might have predisposed her to the reception of the disease. Even if the creating of this predisposition by the prisoners had been clearly proved against them, which was not probable from the evidence, this would have been a very weak ground, upon which to rest a charge of felonious homicide. The maliciously accelerating of the death of another, already labouring under disease, is criminal; but, admitting the probability of the occurrence, it yet remains to be decided whether the proof of merely creating a predisposition to a disorder which proves fatal, would justify a coroner in committing the accused for manslaughter. Lord Hale, in remarking upon the necessity of proving that the act of the prisoner caused the death of the party, says:—"It is necessary that the death should have been occasioned by some corporeal injury done to the party by force, or by poison, or by some *mechanical means*, which occasion death; for although a person may in foro conscientiæ, be as guilty of murder by working on the passions or fears of another, and as certainly occasion death by such means, as if he had used a sword or pistol for the purpose, he is not the object of temporal punishment." (I. 247.)

Several acquittals have taken place of late years, where the deaths of parties have been occasioned by terror or dread of impending danger, produced by acts of violence on the part of the prisoners, not, however, giving rise to bodily injury in the deceased.

It must not be forgotten by a practitioner, that numerous causes of death may be lurking within the system at the time that a wound is criminally inflicted, and therefore a close attention to the symptoms and post-mortem appeaaances can alone assist him in the difficult position in which he may be placed, should the accused party be subsequently brought to trial. A man may be severely wounded and yet death may take place from the bursting of an aneurism, from apoplexy, from phthisis, or other morbid changes which it is here unnecessary to specify. If death can be clearly traced to any of these diseases by an experienced surgeon, the prisoner cannot be charged with manslaughter : for the medical witness may give his opinion that death must have taken place about the same time, and under the same circumstances, whether the wound had been inflicted or not. On these occasions, however, one of the following questions would probably arise :—Was the death of the party accelerated by the wound, or was the disease under which he was labouring, aggravated by the wound, so as to produce, a more speedily fatal termination? The answer to either of these questions must depend on the circumstances of the case, and the witness's ability to draw a proper conclusion from these circumstances. If there were any reasonable doubts upon the subject, the prisoner, according to the humane principles of our law, would have the benefit of it.

It is possible that a man may receive two wounds on provocation, at different times, and from different individuals, and die after the receipt of the second : in such a case, the course of justice may require, that the medical witness should state which wound was the cause of death. Let us take the following illustration :—A man receives, during a quarrel, a gun-shot wound in the shoulder. He is going on well, with a prospect of recovery, when in another quarrel he receives a severe penetrating wound in the chest or abdomen from another person, and after lingering under the effects of these wounds for a longer or shorter period, he dies. If the gun-shot wound were clearly shown to have been the cause of death, the second prisoner could not be convicted of manslaughter; or if the stab were evidently the cause of death, the first prisoner would be acquitted on a similar charge. It might be possible for a surgeon to decide the question summarily, as where, for instance, death speedily follows the second wound, and, on inspection of the body, the heart or a large vessel is discovered to have been penetrated ; or, on the other hand, extensive sloughing sufficient to account for death, might take place from the gun-shot wound, and on inspection, the stab might be found to be of a slight nature, and not involving any vital parts. In either of these cases, all would depend upon the science and skill of the medical practitioner,—his evidence would be so important, that no correct decision could be come to without it; he is, in fact, called upon substantially to distinguish the guilty from the innocent. On some occasions, death may appear to be equally a consequence of either or both of the wounds; in which case, probably, both parties would be liable to a charge of manslaughter.

The second wound, which is here supposed to be the act of another, may be inflicted by the wounded party on himself, in an attempt at suicide, or it may have had an accidental origin. This, however, would produce no alteration in the case; the witness would then have to determine whether the party had not died from the wound inflicted by himself, or from that which he had accidentally received.

It may happen that the wounded person has taken poison, and actually died from the effects of this, and not from the injuries or maltreatment. Two cases of this kind have been related in a former part of this work (antè, p. 78.) Again, the wounded person may have been the subject of further ill-treatment, and the question will be put as to which of the two causes his death was really due. It may be observed of these cases, that the supervening disease, the poison, or the subsequent ill-treatment, should be of such a nature, as to account for sudden or rapid death: since it would be no answer to a charge of death from violence to say that there were marks of chronic disease in the body, unless it were of such a nature as to account for the sudden destruction of life under the symptoms which actually preceded death.

In the medical jurisprudence of wounds, there is probably no case which so frequently presents itself as this: it is admitted that the violence was inflicted, but it is asserted that death was due to some other cause: and the onus of proof lies on the medical evidence. Among numerous cases which have occurred in England during the last twelve years, I find that among the latent causes of death in wounded persons have been—inflammation of the thoracic or abdominal viscera,—apoplexy,—disease of the heart,—phthisis,—ruptures of the stomach and bowels from disease, twisting of the intestines,—and the rupture of deep-seated abscesses. In some of these, the person was in a good state of health up to the time of the violence, in others there was slight indisposition. The history is nearly the same in all:—the popular view was, that the violence was the direct cause of death:—it was only by careful conduct on the part of the medical witnesses, that the true cause was ascertained. It is obvious that questions of malapraxis and life-insurance, giving rise to civil actions, may have a very close relation to this subject. An imputation has often been thrown on the masters of schools, where boys have died soon after they have been chastised. In such cases there has been commonly some unhealthy state of the body to explain this result.

When the disease which gives rise to doubt is seated in a part which is remote from that which sustained the violence, all that is required is, that the post-mortem examination of the body should be conducted with ordinary care. If the disease should happen to be in the part injured, the case becomes much more perplexing. The difficulty can then only be removed by attentively considering the ordinary consequences of such injuries. The violence may have been too slight to account for the diseased appearance; and the disease itself, although situated in the part struck, may be regarded as a most unusual consequence.

A boy was struck two blows on the face by a magistrate:—but they did not appear to have been very severe. The boy went to his work on the following day, but complained of pain in his head: he continued to work for two days, when he was seized with such severe pain that he was obliged to keep his bed. He became worse, and died fourteen days after the injury. A very minute inspection of the body was made, but the only morbid appearance found, was a small tumor on the dura mater corresponding to the posterior face of the petrous portion of the right temporal bone. This satisfactorily accounted for death, but the examiners very properly denied that it had proceeded from the violence, because, 1, the tumors had evidently been for a long time forming, and many months before he was struck, the deceased had complained of his head. 2. It was also wholly improbable that the slight blows, should, under any circumstances, have given rise to the formation of this deep-seated fungous excrescence. (Henke, Zeetschrift der S. A. 1837.) In other instances the case may be of a very doubtful character. A good illustration of this will be found in Med. Gaz. xx. 503, in a case reported by Dr. Hughes, where a boy died apparently from the effects of a blow on the side, and after death peritonitis, ulceration of the bowels, an aperture in the diaphragm and gangrene of the lungs were found.

A remarkable case illustrative of these singular coincidences is reported to have been the subject of a criminal trial in the United States in 1842. A man was stabbed by his wife during a quarrel at a theatre, and he died in about ten minutes afterwards. It was supposed that the deceased had died from the wounds, which consisted of two stabs on the right arm, and one in the region of the stomach: and the prisoner, who believed that she had caused her husband's death, was charged with the murder. From the medical evidence given at the trial, it appeared that there was a large quantity of blood effused in the abdomen, and that the weapon had only perforated the stomach without dividing any considerable blood-vessel to account for such a copious extravasation. It was found that this had proceeded from the rupture of a large aneurism of the abdominal aorta, the parietes of which were so much thinned, that the least excitement was, in tho opinon of the witness, sufficient to cause the accident. The tumor was out of the reach of the knife, which had not penetrated in the direction in which it was lying. The witness admitted that wounds of the stomach were always dangerous, but that sudden death was not a usual consequence of a slight puncture. The prisoner was acquitted.

The following is also in this point of view a remarkable case, which is related by Morgagni. An old man was caught in the act of robbing an orchard—he attempted to escape, but while running away received a blow on the back from the proprietor. The old man went on a few yards, and then fell dead. On inspecting the body, there were no external marks of violence. There was a large effusion of blood in the chest, which was traced to a rupture of the aorta, probably from the vessel being in an aneurismal state. The blow appeared to have been slight, and would probably have produced no evil consequences in a healthy person. (Barzellotti Med. Leg.)

CHAPTER XXXVI.

WAS THE WOUND THE INDIRECT CAUSE OF DEATH?

Certain kinds of injuries are not immediately followed by serious consequences, but the individual may perish after a longer or shorter period of time, and his death may be as much a consequence of the injury as if it had taken place on the spot. Wounds of the head are especially liable to cause death insidiously,—the person may in the first instance recover,—he may appear to be going on well, when without any apparent cause, he will suddenly expire. It is scarcely necessary to observe that a post-mortem examination of the body will suffice to determine whether death is to be ascribed to the wound or not. In severe injuries affecting the spinal marrow, death is not an immediate consequence unless that part of the organ above the origin of the phrenic nerves, be wounded. Injuries affecting the lower portion of the spinal column do not commonly prove fatal, until after some time; but the symptoms manifested by the patient during life, as well as the appearances observed in the body after death, will sufficiently connect the injury with that event.

Death may follow a wound and be a consequence of that wound, at almost any period after its infliction. It is necessary, however, in order to maintain a charge of homicide against an individual, that death should be strictly and clearly traceable to the injury, and not be dependent on any other cause. A doubt on this point, must of course lead to an acquittal.

Many cases might be quoted, in illustration of the length of time which may elapse, before death takes place from certain kinds of injuries,—the injured party having ultimately fallen a victim to their indirect consequences. One of the most striking instances of this kind is that related by Sir A. Cooper, of a gentleman of Yarmouth, who died from the effects of an injury to the head, received about *two years* previously. In this case, the connection of death with the wound, was clearly made out by the continuance of the symptoms of cerebral disturbance during the long period which he survived. A case is reported in the Med. Chir. Rev. where a man died from the consequences of a rupture of the liver which he had sustained *eight years* before (Jan. 1836, p. 296). Did it not rest upon good authority, I should be inclined to reject the following case, which formed the subject of a memoir, read before the Anatomical Society of Paris. An individual received a musket-shot in the left side of the thorax, and the ball remained lodged in the left lung during a period of *twenty-five years*. The ball, in penetrating, had fractured the humerus at its neck, in consequence of which, the upper extremity had been amputated at the shoulder-joint. The wound in the chest soon healed, but the patient remained during life, subject to fits of suffocation and hæmoptysis, under the effects of which he at length sank. On an examination of his body, the ball was found lying behind the third intercostal space in the midst of the pulmonary tissue, but lodged in a kind of cyst which communicated with the bronchi.

There is a singular rule in our law relative to the period at which an individual dies from a wound, namely, that a party shall not be adjudged guilty of homicide, unless death take place within a year and a day after receiving the wound. (Archbold, 345.) In practice the existence of this rule is of little importance, but in principle it is erroneous. Most wounds leading to death, generally destroy life within two or three months after their infliction :—sometimes the person does not die for five or six months, and in more rare instances, death does not ensue until after the lapse of twelve months. These protracted cases more especially occur in respect to injuries of the head. Strict justice demands that the responsibility of a person who has inflicted a wound should depend upon this having really caused death, and not upon the period at which death takes place ; for this must be a purely accidental circumstance. This rule of law had its origin in ancient times, when the connection between death and injuries received, was founded on arbitrary conjecture ; but it is totally inapplicable to the present state of medicine and jurisprudence.

An individual who recovers from the immediate effects of a wound, may die from fever, inflammation or its consequences, erysipelas, tetanus or gangrene ; or an operation, required during the treatment of his wound, may prove mortal. These are what may be called secondary causes of death, or secondary consequences of the wound. The power of deciding on the responsibility of an accused person, for an event which depends only in an indirect manner on the injury originally inflicted by him, rests of course with the authorities of the law. But it is impossible that they can decide on so difficult and nice a question, without satisfactory medical evidence ; and on the other hand, it is right that a medical witness should understand the importance of the duty here required of him.

Fever or erysipelas may follow many kinds of serious wounds, and in some few instances be distinctly traceable to them, but in others, the constitution of the patient may be so broken up by dissipated habits as to render a wound fatal, which in a healthy subject might have run through its course mildly, and have healed. When the fever or erysipelas is readily to be traced to the wound, and there is no other apparent cause of aggravation to which either of these disordered states of the body could be attributed, they can scarcely be regarded by the medical practitioner as very unexpected or unusual consequences of such injuries, especially when extensive, or when seated in certain parts of the body, as the scalp ; therefore, if death take place, it does not appear unjust that the prisoner should be as much responsible for the result as if the wound had proved directly mortal. This principle has already been admitted by our law, with regard to tetanus; and, indeed, were it not so, many reckless offenders would escape, and many lives would be sacrificed with impunity. It is difficult to lay down a general rule, upon a subject which is liable to vary in its relations in every case; but when a wound is not serious, and the secondary cause of death is evidently due to constitutional peculiarities from acquired habits of dissipation, the ends of justice are probably fully answered by an acquittal; in fact, such cases do not often pass beyond a coroner's inquest.

These secondary causes of death may be arranged in three classes:

I. THE CAUSE IS UNAVOIDABLE.—Of this kind are tetanus, following laceration of tendinous and nervous structures,—erysipelas following lacerated wounds of the scalp,—peritoneal inflammation following rupture of the bladder or intestines, with extravasation of their contents,—strangulation of the intestines, as phrenic hernia, following rupture of the diaphragm, and others of the like nature. Here supposing proper medical treatment and regimen to have been pursued, the secondary cause of death was unavoidable and the fatal result certain.

II. THE CAUSE MIGHT HAVE BEEN AVOIDABLE BY GOOD MEDICAL TREATMENT.—There are, it is obvious, many kinds of wounds which, if properly treated in the first instance, may be healed and the patient recover, but when improperly treated, they may prove fatal. In the latter case, it will be a question for the witness to determine, how far the treatment aggravated the effects of the violence, and from his answer to this, the jury may have to decide on the degree of criminality which attaches to a prisoner. Let us suppose, for instance, that an ignorant person has removed a clot of blood, which sealed up the extremity of a vessel, in consequence of which, fatal hæmorrhage has ensued,—or that he has produced death by unnecessarily interfering with a penetrating wound of the thorax or abdomen,—it would scarcely be just, morally speaking, to hold the aggressor responsible, as but for the ignorance and unskilfulness of his attendant, the wounded party might have recovered from the effects of the wound.

When death is really traceable to the negligence or unskilfulness of the person who is called to attend on a wounded party, this circumstance ought to be admitted in mitigation; and such would probably be the case, supposing that the wound had not been inflicted under circumstances, which, in the opinion of the judge, would make the offence amount to murder. In this case, the responsibility of a prisoner is not made to rest upon the death of the wounded party, for even if the latter should recover from the effects of the wound, he is liable to be tried on a capital charge.

In relation to this medico-legal question, Lord Hale observes: "It is sufficient to constitute murder, that the party dies of the wound given by the prisoner, although the wound was not originally mortal, but became so in consequence of negligence or unskilful treatment; but it is otherwise where death arises not from the wound, but from unskilful applications or operations used for the purpose of curing it." (1.428.) The medical jurist will perceive that a very nice distinction is here drawn by this great judge, between death as it results from a wound rendered mortal by improper treatment, and death as it results from the improper treatment, irrespective of the wound. In the majority of cases such a distinction could scarcely be established, except upon conjectural grounds, and probably in no case would there be any accordance in the opinions of medical witnesses. In slight and unimportant wounds, it might not be difficult to distinguish the effects resulting from bad treatment, from those connected with the wound, but, there can be but few cases of severe injury to the person, wherein a distinction of this nature could be safely made.

It will be obvious that rather a serious responsibility is thrown on practitioners who undertake the management of a case of criminal wounding. Any deviation from common practice should then be made with the greatest caution, since novelties in practice will, in the event of death, form one of the best grounds of defence in the hands of a prisoner's counsel. On these occasions, every point connected with the surgical treatment, is rigorously inquired into. In the case of a severe lacerated wound to the hand or foot, followed by fatal tetanus, it may be said that the wounded person would not have died, had amputation been performed. In this case, however, a practitioner may justify himself by showing that the injury was too slight to require amputation, or that the health or other circumstances connected with the deceased would not allow of its being performed with any fair hope of success. On the other hand, if the practitioner performed amputation, and the patient died, then it would be urged, that the operation was unjustifiable, and had caused death. Here the surgeon is bound to show, that the operation was necessary, according to the ordinary rules of treatment.

The treatment of severe incised wounds of the throat, where the trachea is involved, sometimes places a practitioner in an embarrassing position. If the wound be left open, death may take place from hæmorrhage: if it be prematurely closed, the blood may be effused into the trachea and cause death by suffocation.

The following case occurred a few years since in London. A man inflicted a transverse wound on his throat; it was about four inches in length, and passed across the middle of the thyroid cartilage. There was no considerable hæmorrhage, and the carotid arteries had escaped being wounded. The external orifice had, in the first instance, been closed, and the patient was almost suffocated, partly by the occurrence of emphysema, and partly by the blood flowing into the trachea. On opening the wound, the patient's breathing was relieved and a quantity of mucus mixed with blood was thrown out from the trachea at each expiration. After waiting some time, the pieces of divided cartilage were brought together by sutures, and the wound carefully closed. In a very short time the breathing became difficult, the countenance livid, and the man died apparently suffocated.

Another case occurred in the neighbourhood of London, in June 1841. A woman was found in her bed one morning with her throat severely cut, and a man was charged with the crime of murder. The wound had divided the trachea and the superficial vessels. Although medical assistance was called in, it appears that nothing was done to arrest the hæmorrhage for three quarters of an hour. The wound was then closed by ligatures, and the woman died immediately,—most probably from suffocation. The accused was tried and acquitted—it appeared that this was an act of suicide. The first object of the surgeon, in all such cases, is to save life:—therefore hæmorrhage should be immediately arrested by securing the divided vessels. When this is done, the wound may be closed,—but if the closure take place before this, death from suffocation will commonly follow.

3. THE CAUSE MIGHT HAVE BEEN AVOIDABLE HAD PROPER CARE BEEN TAKEN BY THE WOUNDED PERSON, OR HAD HE FOLLOWED THE ADVICE OF HIS MEDICAL ATTENDANT.—A man who has been severely wounded in a quarrel, may obstinately refuse medical assistance, or he may insist upon taking exercise, or using an improper diet, contrary to the advice of his medical attendant, or, by other imprudent practices, he may thwart the best conceived plans for his recovery. Let us take a very common case as an illustration. A man receives a blow on the head in a pugilistic combat, from the first effects of which he recovers, but after having received surgical assistance, he indulges in excessive drinking, and dies. The aggressor is tried on a charge of manslaughter, and found guilty. Death under these circumstances is commonly attributed by the medical witness to extravasation of blood on the brain; but it cannot be denied that the excitement produced by intoxicating liquors, will sometimes satisfactorily account for the fatal symptoms. In the case which we are here supposing, such an admission might be made, and the prisoner receive the benefit of it consistently with the proper administration of justice; for the imprudence or negligence of a wounded party ought not, morally or legally speaking, to be considered as adding weight to the offence of the aggressor. Of course it is presumed that there should be a fair prospect of recovery, so far as a prognosis could be given, for if the symptoms should be from the first unfavourable, the circumstances could hardly be held out in mitigation. The more clearly the medical witness is able to trace death to imprudence or excess, on the part of the deceased, the more obviously would the responsibility of a prisoner be diminished; and hence the necessity for attending to the progress of a wound, which if it prove fatal, may involve another in a criminal charge. The legal responsibility of the assailant is the same, whether the deceased die on the spot, or some days afterwards, unless it can be distinctly proved that his death was immediately connected with the imprudence or excess of which he was guilty, and wholly independent of the wound. But, although a prisoner should be found guilty of manslaughter under these circumstances, the punishment is so adjusted by our law, as to leave a considerable discretionary power in the hands of a judge. This is, indeed, tantamount to a direct legal provision, comprehending each different shade of guilt;—a man is held responsible for a wound rendered accidentally mortal, by events over which he could have no control, and which in themselves ought to be regarded

as in some degree exculpatory; but the punishment attached to his offence will be severe or slight, according to the representation made by a medical witness, of the circumstances which rendered the wound mortal; if he neglect to state the full influence of imprudence or excess on the part of the wounded person, where it has existed, over the progress of the wound, he will probably cause the prisoner to be punished with undue severity. The humanity of our judges is such, that when medical evidence is clear and consistent on a point of this nature, and there are no circumstances in aggravation, they commonly pass a mild sentence.

It might here be a question whether we are to class among acts of negligence on the part of a wounded person, sufficient to mitigate the offence of a prisoner, the not calling in a medical practitioner, or the refusing to receive medical advice. A wound susceptible of being cured, might thus prove mortal, and the prisoner be convicted of manslaughter. See the Queen v. Thomas, infrà.

A man may receive a lacerated wound of an extremity, which is followed by tetanus or gangrene and thus proves fatal;—he may have obstinately refused amputation, although proposed by his medical attendant when first called, but this would scarcely be held as a mitigating circumstance on the part of a prisoner; because the wounded party is not compelled to submit to an operation, and the medical witness could not always be in a condition to swear that the operation would have positively saved his life; he can merely affirm that it might have afforded the deceased a chance of recovery.

In the case of the Queen v. Hulme, (Liverpool Aut. Assizes, 1843,) it was proved that the deceased had died from tetanus, caused by an injury to a finger some time before. Amputation was advised by the surgeon, but the deceased would not consent to the operation. The prisoner was convicted of manslaughter, and sentenced to the severest punishment prescribed by the law for that crime.

Again, a person may receive a blow on the head, producing fracture with great depression of bone, and symptoms of compression of the brain;—a surgeon may propose the operation of trephining to elevate the depressed bone, but the friends of the wounded man will not permit the operation to be performed. In such a case, his line of duty will be to state the facts to the court, and it is probable, that here, at least, some mitigation of punishment might take place, on conviction; because such an injury, if left to itself, must in general prove mortal, and no doubt could exist in the mind of any surgeon, as to the absolute necessity for the operation.

It would appear from the case of the Queen v. Thomas and others, (Gloucester Aut. Ass. 1841,) that the mere neglect to call in medical assistance is not allowed to be a mitigatory circumstance, in the event of death ensuing. The deceased died from the effects of a severe injury to the head inflicted by the prisoners, but had had no medical assistance. The judge said it was possible that "if he had had medical advice he might not have died; but whoever did a wrongful act must take the whole consequences of it. It never could make any difference, whether the party injured had or had not the means or the mind to apply for medical advice." The prisoners were convicted. According to Lord Hale, if a man be wounded, and the wound turn to a gangrene or fever, for want of proper applications, or from neglect, and the man die of gangrene, or fever, this is also such a killing as would constitute murder. (Archbold, 345.)

IV. THE CAUSE MIGHT HAVE BEEN AVOIDABLE BUT FOR AN ABNORMAL OR UNHEALTHY STATE OF THE BODY OF THE WOUNDED PERSON.—Wounds which are comparatively slight, sometimes prove indirectly fatal, owing to the person being in a diseased or unhealthy state, at the time of their infliction. In bad constitutions, compound fractures or slight wounds are followed by gangrene, fever, or erysipelas, proving fatal, which in a healthy subject would probably have had a favourable termination. Here the responsibility of an assailant for the death sometimes altogether ceases; for the consequence may be, medically speaking, unusual or unexpected, and but for circumstances wholly independent of the act of the accused, would not have been likely to destroy life. In general, this is the point to which the law closely looks, in order to make out the responsibility of the accused:—namely, that the fatal secondary cause must be something not unusual or unexpected as a consequence of the particular injury, and the medico-legal question presents itself under this form:—Would the same amount of injury have been likely to cause death in a person of ordinary health and vigour?

Men who have suddenly changed the habits of living, and have passed from a full diet to abstemiousness, are unable to bear up against comparatively slight injuries and often sink from their secondary consequences.

So a man otherwise healthy labouring under hernia, may receive a blow in the groin attended with rupture of the intestine, gangrene and death,—another with a calculus in the kidney may be struck in the loins, and die in consequence of the calculus perforating the renal vessels, and causing fatal hæmorrhage, or from subsequent inflammation.

Mr. Crosse, of Norwich, has reported to the Medico-Chirurgical Society, the case of a boy, aged ten, who received a slight blow on the abdomen, and died in a very unexpected manner, on the second day after the injury. On inspection, a cyst capable of holding ten or twelve ounces of liquid, was found connected with the under surface of the liver. The cyst had been ruptured by the blow, and its contents had escaped into the abdomen. But for the cyst existing in this situation the blow would not have been attended with dangerous consequences. In cases of this kind the effects of the violence must be regarded as something unexpected:—it would not have produced serious mischief in an ordinarily healthy person, and hence the responsibility of an assailant becomes much diminished. The crime is undoubtedly manslaughter, but the punishment would be of a mild description. A defence of this kind will however be limited by circumstances. A case is reported where a Dr. Fabricius was tried at the Old Bailey for the murder of his female servant by striking her a blow behind the ear, whereby a large abscess situated at that part, was ruptured, and this ultimately caused her death. The chief question on the trial was, whether the deceased had died from the effects of the violence or of the disease under which she was at the time labouring. The doctor ingeniously urged in his defence that he had struck the blow merely with the purpose of opening the abscess! The jury, however, did not agree in taking this scientific view of the matter, and they found him guilty of manslaughter. In the case of the Queen against Bell and others, Nott. Aut. Assizes, 1841, it was proved that the deceased had died from the effects of a blow received in a prize fight, which had ruptured an abscess in the kidney, evidently of long standing. The prisoners were convicted.

It must be evident that there exist numerous other internal diseases, such as aneurism, and various morbid affections of the heart and brain, which are liable to be rendered fatal by slight external violence. Now the law, as applied to these cases, is thus stated by Lord Hale:—"It is sufficient to prove that the death of the party was accelerated by the malicious act of the prisoner, although the former laboured under a mortal disease at the time of the act." (1. 428.) In those cases, where a slight degree of violence has been followed by fatal consequences, it is for a jury to decide under all the circumstances of the case, upon the actual and specific intention of the prisoner at the time of the act which occasioned death. And, according to Starkie, "it seems that in general, notwithstanding any facts which tend to excuse or alleviate the act of the prisoner, if it be proved that he was actuated by prepense and deliberate malice, and that the particular occasion and circumstances upon which he relies, were sought for and taken advantage of merely with a view to qualify actual malice, in pursuance of a preconceived scheme of destruction, the offence will amount to murder."

In most of these cases there is an absence of intention to destroy life: in general, the very nature of the wound, as well as the means by which it was inflicted, will suffice to develope the intention of the prisoner. An accurate description of the injury, if slight, will often afford strong evidence in favour of the prisoner, since the law does not so much regard the means used by him to perpetrate the violence, as the actual intention to kill or to do great bodily harm.

Serious injury, causing death by secondary consequences, will admit of no exculpation when the prisoner was aware, or ought to have been aware of the condition of the party whom he struck. Thus if a person notoriously ill or a woman while pregnant, be violently maltreated and death ensue from a secondary cause, the accused would be held responsible; because he ought to have known that violence of any kind to persons so situated must be attended with dangerous consequences. So if the person maltreated be an infant or an infirm and decrepid old man, it is notorious that a comparatively slight degree of violence will destroy life in these cases; and the prisoner would properly be held responsible. A difference, however, is commonly made between those cases where death arises indirectly from a secondary cause following a wound, and those where the injury merely accelerates the fatal event.

When the accused could not have been aware of the existence of a diseased or an abnormal condition of parts in the wounded person, the question is somewhat different. In many individuals the skull is preternaturally thin, and in most persons it is so, in those places corresponding to the situation of the glandulæ Pacchioni. In a case of this kind a moderate blow might cause fracture, accompanied by effusion of blood,—depression of bone—or subsequent inflammation of the brain and its membranes, any of which causes might prove fatal. An important trial involving this question occurred at the Norwich Summer Assizes, in 1842. (The Queen against Dowde.)

The prisoner, who was a policeman, was charged with manslaughter. The deceased it appears attempted to escape from the custody of the prisoner, and the latter, in endeavouring to prevent his escape, struck the deceased a blow on the head. The deceased spoke of the blow as trifling, and with the exception of a slight head-ache, he made no complaint. On examining his head, there was a very slight cut, and a small effusion of blood. The deceased was placed in a cell, and some hours afterwards was found dead. On inspection, the skull was found fractured for an inch and a half over the seat of violence, and a quantity of blood had been effused and had caused death. The medical evidence on the trial was to the effect, that the blow did not appear to have been violent—that the skull of the deceased was preternaturally thin, not being more than one-twelfth of an inch in thickness at the fractured part. All agreed that the fracture might in this case have been caused by a blow, which, under ordinary circumstances, would have been attended with no serious mischief.

In some persons, all the bones of the body are unusually brittle, so that they are fractured by the slightest force. Inflammation, gangrene and death may follow, when no considerable violence has been used, but these being unexpected consequences and depending on an abnormal condition of parts unknown to the prisoner, his responsibility will not be so great as under other circumstances. This condition of the bones can only be determined by a medical practitioner. Facts of this kind show that the degree of violence used in an assault cannot always be measured by the effects, unless a careful examination of the injured part be previously made.

Some German medical jurists have contended that an unnatural transposition of parts should become a mitigating circumstance,—as when, for example, the heart or some large vessel is found out of its position and there wounded; but this doctrine would receive no sanction from an English court of law, as the responsibility of persons for these criminal offences, does not rest upon the perfect anatomical structure of the deceased! At the same time, it might become a question whether if death occurred from a superficial wound,—whereby a large artery taking an abnormal course, was divided,—there might not be cæteris paribus some ground for diminishing the degree of responsibility.

When a person is charged with having caused the death of another through violence terminating in some fatal disease, the case often admits of an able defence, and this in proportion to the length of time after the violence, at which the deceased dies. The disease, it may be urged, is liable to appear in all persons, even the most healthy,—or it may have arisen from causes unconnected with the violence. In admitting these points, it must be remembered that death may be proved to have been indirectly a consequence of the wound by the facts:

1, that the supervention of the secondary cause, although not a common event, lay in the natural course of things; 2, that there did not exist any accidental circumstances which were likely to have given rise to this secondary cause independently of the wound. The proof of the first point amounts to nothing, unless the evidence on the second point be conclusive. According to Lord Hale, if a man have a disease which in all likelihood would terminate his life in a short time, and another give him a wound or hurt which hastens his death, this is such a killing as constitutes murder. (Archbold, 345.)

Tetanus.—This disease frequently presents itself as a secondary fatal consequence of wounds,—more especially of those which are lacerated or contused, and affect nervous or tendinous structures. It has often occurred as a result of very slight bruises or lacerations, where the injury was so superficial as to excite no alarm; and it is a disease which gives no warning of its appearance. It is very important for a medical jurist to know that it may come on spontaneously, i. e. independently of the existence of any wound on the body. Many cases have been brought into the London hospitals where the only cause of this disease, appeared to be exposure to cold or wet,—or exposure to a current of air. It has sometimes come on without any apparent cause. In endeavouring to connect its appearance with a particular wound or personal injury, it will be proper to observe: 1, whether there were any symptoms indicative of it before the maltreatment: 2, whether any probable cause could have intervened to produce it, between the time of its appearance and the time at which the violence was inflicted: 3, whether the deceased ever rallied from the effects of the violence. The time at which tetanus usually makes its appearance, when it is the result of a wound, is about the third or fourth day.

Many trials for wounding have occurred in this country of late years, where tetanus was the immediate cause of death; and the defence has generally rested upon the probable origin of the tetanus from accidental causes. Perhaps among these that of Captain Moir, who was tried at the Chelmsford Assizes in 1830, for the murder of a fisherman, is one of the most interesting, as it developes the rule of law in regard to criminal responsibility, when death takes place from secondary causes.

The deceased had repeatedly trespassed on the grounds of the prisoner, but, notwithstanding the frequent warnings which he had received, he set the prisoner at defiance. On the day laid in the indictment, the prisoner, while riding, met the deceased crossing his grounds, in order to pursue his usual occupation of fishing. An angry altercation took place, and the deceased refused to return: the prisoner, in a high state of irritation, then rode back to his house, which was at some distance from the spot; and, having procured his pistols, rode off after the deceased, and overtook him in the act of continuing the trespass. Words again ensued between them, and the prisoner then fired at the deceased and wounded him severely in the arm. The muscles, vessels, and nerves were extensively lacerated, but so far as I have been enabled to learn the particulars, no question seems to have been raised as to the propriety of immediate amputation. The deceased lingered a short time: tetanus supervened, under which he died. On the trial, the medical evidence went to show that death was caused by tetanus brought on by the severe gun-shot wound inflicted by the prisoner. In his defence, it was alleged that he shot the deceased under provocation; and that he had not intended to kill him, for he had purposely aimed at the arm. With regard to the first point, the judges held that the fact of his returning to his house, to fetch a weapon capable of inflicting a mortal wound, was a proof of deliberate malice; while, with regard to the second point, there could be no extenuation, since a serious wound inflicted on an extremity may destroy life as readily as a wound inflicted on the trunk. The prisoner was found guilty and executed, but his execution was considered by many to be summum jus.

In this case, the connection of the secondary cause of death, with the original wound, appeared to be so clear, that not a doubt existed in the minds of the professional witnesses; and the law held the prisoner to be as much responsible for the fatal result, as if he had killed the deceased on the spot.

The next point which we have to consider is the degree of responsibility which attaches to an assailant, when death takes place from an operation, rendered necessary in the treatment of a case.

V. DEATH FROM SURGICAL OPERATIONS.—It must here be presumed, that the operation is imperatively necessary, and that it has been skilfully performed; for these are two conditions, without the existence of which, the responsibility of a prisoner for fatal consequences, could hardly be entertained. A prudent practitioner would, therefore, never operate under the circumstances here supposed, without requiring the advice and assistance of his brother-practitioners; otherwise, as it has been observed, a criminal may escape punishment, at the expense of the surgeon's reputation. There is no specific provision on this point in our law. According to Lord Hale, if death takes place from an unskilful operation, performed for the cure of a wound, and not from the wound, the responsibility of a prisoner ceases; but this eminent lawyer does not appear to have contemplated, that death might take place as a consequence of the most skilful operation required for the treatment of a wound, and yet be wholly independent of the wound itself. A wounded person may sink from the mere shock of an operation, or he may die from the quantity of blood unavoidably lost during its performance. On the other hand, he will apparently be going on favourably, when secondary hæmorrhage may take place, and suddenly destroy him.

The operation may also take an unfavourable turn in its results, if the individual be at the time the subject of internal organic disease, in which case, it seems reasonable that the responsibility should be considerably diminished. Mr. Travers observes, that,—A pre-existing disease of the liver, kidney, or testicle, though chronic, and in itself not alarming to the constitution, becomes a drag upon its elasticity, and stands in the way of recovery. Inspection of the body after death, frequently explains the unfavourable result of operations that promise well, by discovering one or more organs in a state of chronic disease, which had not previously deranged the health in a degree sufficient to give notice of its existence; and which might, therefore, have remained quiet for years to come, had no extraordinary call been made upon the powers of the system. (On Constitutional Irritation, p. 45, 121, et seq.)

Should an operation be unnecessarily and unskilfully performed, the responsibility of an aggressor would of course cease, if the death of a wounded party could be clearly ascribed to it. Thus if in carelessly bleeding a wounded person, the brachial artery should be laid open, or if in performing amputation, a large artery be imperfectly secured, so that the patient in either case, die from hæmorrhage, the prisoner is not responsible; because it would be punishing him for an event depending on the unskilfulness of the medical practitioner. But supposing the bleeding or amputation to be performed with every proper care and skill; and yet, in the one case, phlebitis, and in the other tetanus, gangrene, or fever should destroy life, the prisoner will be differently situated.

The practice of the law is strictly consistent with justice. If the operation be *absolutely* required for the treatment of a wound,—if it be performed with ordinary skill, and still death ensue as a direct or indirect consequence, the prisoner will be held responsible for the result. It is presumed in these cases, that if the patient were left to himself he would, in all probability, die from the effects of the wound. If, therefore, a surgeon, knowing that an operation would give a chance of saving life on such an occasion, did not perform it, it might be successfully contended in the defence, that the deceased had died, not from the wound, but from the incompetency and neglect of his medical attendant. Hence it follows, that if during this very necessary treatment, unforeseen though not unusual causes cut short life, no exculpation should be admissible, if it went to attack the best directed efforts made for the preservation of life.

By an operation being absolutely required, we are to understand that it is necessary to preserve life. Bleeding and cupping may be necessary in the treatment of a wounded person; but unless it could be sworn that this treatment was required for the preservation of life, it is doubtful whether, in the event of death occurring from these simple operations, the assailant would be held responsible for the fatal result.

In 1827, two persons were tried in Edinburgh, for capitally assaulting another, by throwing sulphuric acid over him. The death of the deceased was clearly due to phlebitis and concomitant fever, following the operation of venesection, which was considered necessary in the treatment of the case. It did not appear that this bleeding was absolutely necessary for the preservation of life, but merely for the prevention of severe ophthalmia. The charge of murder was therefore abandoned:—this question of responsibility for the fatal result, being considered to involve too nice a point to ensure conviction.

Death is by no means an unusual result of severe operations, the secondary consequences under which the patient may die, being very numerous even when the case is most skilfully managed. Sometimes the patient will die on the table, although but little blood may have been lost:—in a case related by Dr. Evans, of Galway, the patient, a healthy man, who had sustained a severe injury by an accident, died in a few moments after his leg had been amputated, although he had not lost more than four ounces of blood. Fear, pain, and sudden shock to the nervous system have caused death under these circumstances. The most common indirect causes of death after these operations, are tetanus and hectic fever with gangrene of the stump. If the operation were really necessary, and it ultimately proved fatal, the prisoner would be responsible for the death.

An interesting case involving this question was tried at the Limerick Spring Assizes, in 1836. It was communicated to me by Dr. Geoghegan, of Dublin. The deceased received a comminuted fracture of the leg produced by blows. He was taken to an hospital, when signs of mortification began to make their appearance in the injured limb. It was proposed on a consultation of surgeons, to remove the limb. Amputation was skilfully performed, and there were some hopes of recovery; but in ten days, tetanus came on as a result of the operation, and the man died. The persons who inflicted the injury were indicted and convicted of the murder. The conviction was confirmed by a conference of the judges. (The King against Michael Quain and others.)

When a wounded person is taken to an hospital in which gangrene or erysipelas is diffusing itself by infectious propagation, and he is attacked by one of these diseases before or after the performance of an operation, and dies, it is doubtful whether a prisoner would be held responsible for the result, unless the disease were proved to be not an unusual consequence of the injury so inflicted. It might be contended, that the transportation of the wounded man to such a locality was not absolutely necessary to the preservation of his life; and that he would not then have died but for the accidental presence of an infectious disease. Cases of this kind cannot be easily decided by general rules; but the question has already been raised before a legal tribunal, in a trial which took place at the Maidstone Lent Assizes, 1839. (The Queen against Connell and others.)

The deceased was assaulted by a number of soldiers, and received two blows on the head with a stick. The wound was not of any great extent, and the deceased did not appear to suffer much from it. Two days afterwards, he was attacked by erysipelas in the head and face, and he died in about a week. On inspection, there were no appearances of disease. The surgeon referred death to erysipelas, which was prevalent in the hospital, at the time the deceased was brought in. The man would probably have recovered but for the attack of erysipelas, and he did not think that he would have been attacked by that disease but for the wound. Erysipelas was an infectious disease and a common consequence of wounds of the head. Upon this evidence the prisoners were convicted.

It is sometimes very difficult to establish the connection of the *erysipelas* with a wound, especially when the disease occurs in a remote part of the body not implicated in the wound. The following case was tried before the Justiciary Court at Glasgow, in 1822.

A gamekeeper to Lord Blantyre, was indicted for the murder of a poacher, whom he shot so severely in the left arm, that it was found necessary to perform amputation above the elbow. The man died of erysipelas in the right leg; and the question on the trial was, whether the erysipelas was brought on by the gun-shot wound or not. Upon this question, there was great difference of opinion among the medical witnesses. One gave it as his opinion. that the debility caused by the wound, brought on the disease of which the deceased died. Another thought that the tendency to erysipelas had existed long before the man received the wound. It appeared in evidence, that the deceased had been out for two nights in the exercise of his vocation, and had slept without shelter,—that during this time, he had eaten but little, and above all, that he had a foul ulcer in his leg, the absorption from which, in the opinion of some of the witnesses, laid the foundation of the disease before the injury was received. Under all these circumstances," observes the reporter, "what would have been the best mode of treatment in such a case, supposing the deceased had received no wound at all? Undoubtedly," he continues, "the very treatment which he did receive in consequence of it;—copious bleeding,—light diet,—and perfect rest: while the counter irritation from the amputation, so far from increasing the inflammation which was going on in the groin, must have acted like a blister or a seton in repressing and counteracting it!" The jury seem to have agreed in this view of the case, for the prisoner was acquitted of the charge. (Beck's Med. Journ.)

Taking the circumstances as they are above reported, it certainly did not appear that the erysipelas was directly connected with the wound, and unless this had been clearly and satisfactorily proved, it would have been unjust to have made the prisoner responsible for the fatal consequences. The bad habit of body and the actual existence of disease in the leg, were facts in themselves sufficient to render such an opinion improbable.

These questions relative to responsibility in death following operations, would come more frequently before courts of law, were it not that the cases are stopped in the Coroners' courts by a verdict of accidental death. (See Med. Gaz. xix. 157.) It unfortunately happens that on these occasions, there is great difference of opinion among medical witnesses respecting the connection of the disease with the death, or indeed the necessity for the operation itself. The evidence of opinion in favour of the prosecution, is sometimes exactly balanced by that urged in the defence; and under these circumstances the only alternative left to the court, is to discharge the accused. Differences of opinion upon these subjects among eminent members of the profession, too justly convey to the public, the impression that there are no fixed principles upon which medical opinions are based; and consequently that it would be dangerous to act upon them. Thus it is that we are accustomed to hear of a medical prosecution and a medical defence, as if the whole duty of a medical jurist consisted in his making the best of a case, on the side for which he happens to be engaged, adopting the legal rule of suppressing those points which are against him, and giving an undue prominence to others which may be in his favour. This is an unfortunate condition of things, for which at present there appears to be no other remedy, than that of appointing a medical board of competent persons to whom such questions might be referred, in the same way as questions relative to navigation are referred by the Admiralty Courts to a board formed of members of the Trinity House,—professionally acquainted with the matters in litigation.

CHAPTER XXXVII.

FOR HOW LONG A TIME HAS THE WOUND BEEN INFLICTED? HOW LONG DID THE DECEASED SURVIVE?

The period of time at which a particular wound was inflicted, may become a medico-legal question, both in relation to the living and the dead. The identity of a person and the correctness of a statement made by an accused party, may be sometimes determined by an examination of the wound or its cicatrix. So, if a dead body be found with marks of violence upon it, and evidence adduced that the deceased was maltreated at some particular period before his death, it will be necessary for a practitioner to state whether, from the appearance of the injuries, they could or could not have been inflicted at or about that time.

A case was tried at the Taunton Spring Assizes, 1841, (the Queen against Raynon,) wherein evidence of this kind served to disprove the statement made by the accused. He was charged with maliciously cutting and wounding the prosecutrix. There was a cut upon his thumb, which he accounted for by saying it was from an accident which occurred three weeks before. The medical witness declared, on examining it, that it could not have been done more than two or three days, which brought the period of its infliction to about the time of the murderous assault. This and other circumstances led to his conviction.

An incised wound inflicted on the living body, gradually heals by adhesion where no circumstances interfere to prevent the union of the edges. For eight or ten hours the edges remain bloody,—they then begin to swell, showing the access of inflammation. If the parts be not kept well in contact, a secretion of a serous liquid is poured out for about thirty-six or forty-eight hours. On the third day this secretion acquires a purulent character. On the fourth and fifth days, suppuration is fully established, and it lasts five, six, or eight days. A fibrous layer then makes its appearance between the edges, which is at first soft and easily broken down:—this causes them gradually to unite, and thus is produced what is termed a *cicatrix*. Cicatrization is complete about the twelfth or fifteenth day, when the wound is simple, of little depth, and only affecting parts endowed with great vitality. The length of time required for these changes to ensue will depend—1. On the situation of the wound,—wounds on the lower extremities are longer in healing, than those on the upper part of the body. If the wound be situated near a joint, so that the edges are continually separated by the motion of parts, cicatrization is retarded. 2. On the extent. Wounds involving many and different structures, are longer in healing than those simply affecting the skin and muscles. 3. On the age and health of the wounded party;—the process of cicatrization is slow in those who are diseased or infirm.

In an incised wound, the cicatrix is generally straight and regular:—but it is semilunar if the cut be oblique. It is soft, red and tender if cicatrization be recent:—it is hard, white, and firm, if of long standing. On compressing the skin around an old cicatrix, its situation and form are well marked by the blood not entering into it on removing the pressure. It has been said, that the cicatrices of incised wounds are linear, but that is not always the case:—in general, they are more or less elliptical, being wider in the centre than at the two ends,—this appears to be due principally to the elasticity of the skin and the convexity of the subjacent parts:—thus it is well known, that in every wound on the living body the edges are much separated in the centre, and this physical condition influences the process of cicatrization. When the wound is in a hollow surface, or over a part where the skin is not stretched, as in the axilla or groin, then the cicatrix may be linear or of equal width throughout.

If there were any loss of substance in an incised wound, or if the wound were lacerated or contused, the cicatrix would be irregular, and the healing would proceed by granulation. The process might here occupy five, six, or eight weeks, according to circumstances. When healed, the cicatrix would be white and have a puckered appearance;—the surface of the skin would be uneven.

Is a cicatrix always a consequence of a wound? If we here use the term wound in the sense in which it is commonly employed in jurisprudence,—i. e. where the breach of continuity affects the layers of the true skin, a cicatrix is always produced in the process of healing. In even cuts made by a very sharp instrument, especially if they be in the direction of the fibres of subjacent muscles, and the parts be kept in close apposition, the cicatrices are even, linear, and sometimes so small, as to be scarcely perceptible. If, besides, the skin be white, they may be easily overlooked. Wounds of this kind, are not, however, commonly the subject of a medico-legal inquiry. If then on examining a part, where at some previous time, a stab or a cut is alleged to have been received, we find no mark or cicatrix, it is fair to assume that the allegation is false, and that no wound has been inflicted. Mere abrasions of the cuticle, or very slight punctures and incisions, often heal without leaving any well-marked cicatrix.

Is a cicatrix when once formed ever removed, or so altered by time as to be no longer recognizable? This is rather an important question, which sometimes presents itself to a medical jurist both in civil and criminal proceedings. Those who have given close attention to this subject, agree in considering that cicatrices when they are once so produced in the cutis as to be easily perceptible, are indelible. They undergo no sensible alteration in their form or other external characters. The tissue of which a cicatrix is formed is different from that of the skin:—it is harder and less vascular, and is destitute of rete mucosum, so that its whiteness, which is particularly remarkable on the cicatrized skin of a negro, is retained through life. If any cicatrices were easily obliterated, it would be those which are even and regular,—the results of incised wounds by sharp instruments; but from my own observation, I can undertake to say, that cicatrices of this kind have certainly retained their characters unchanged in one instance for twenty, and in another twenty-five years. According to the observations of Dupuytren and Delpech, the substance of a cicatrix is not converted into true skin:—it never acquires a rete mucosum. In the cicatrices of lacerated and contused wounds, the form of the weapon with which the wound was inflicted, is sometimes indicated. It is not easy to distinguish the cicatrix of a stab from that produced by a pistol-bullet fired from a distance. In both cases the edges may be rounded and irregular, unless the stab has been produced by a broad-bladed weapon.

It is important to observe that all cicatrices are of smaller size than the original wound; for there is a contraction of the skin during the process of healing. This is especially observed with regard to the cicatrix of a stab. The recent wound, as it has been elsewhere stated, (antè, p. 301) is apparently smaller than the weapon, and the resulting cicatrix is always smaller than the wound. Hence it is diffcult to judge of the size of the weapon from an examination of the cicatrix. In gun-shot wounds, if the projectile has been fired from a distance, the cicatrix is of less diameter than the ball:—it represents a disk depressed in the centre and attached to the parts beneath; while the skin is in a state of tension from the centre to the circumference. If the bullet have been fired near the body,—the cicatrix is large, deep and very irregular. If the projectile have made two apertures, the aperture of exit is known by the greater size and irregularity of the cicatrix.

When an individual is not seen until after death, and there are recent wounds on his body, a medical jurist may be required to state, at what period they were probably inflicted. It may be taken as a general rule, that there are no appreciable changes in any wound until eight, ten, or twelve hours have elapsed from the time of its infliction; then we have the various phenomena of adhesion, suppuration, or gangrene, during any of which stages the wounded person may die. Some remarks have already been made on the time at which adhesion and suppuration become established in wounds; and with respect to gangrene, it may be observed, that the deceased must have survived at least fifty hours, in order that this process should be set up:—in old persons it may take place earlier. We must take care not to confound the effects of putrefaction on a wound with those of gangrene. Putrefaction always commences sooner in parts which are wounded than in those which are unaffected; but the general appearance of the body, will show whether or not the changes in the wound are due to putrefaction. The collapse of the eye will indicate this process; while the presence of warmth or rigidity of the members will show that death must have been too recent for putrefaction to have become established.

The time at which a severe contusion has been produced, may be commonly determined by noting the changes of colour which take place around it. It is rarely until after the lapse of twenty-four or thirty-six hours that these changes of colour appear. (See Ecchymosis, antè, p. 289.) The livid circumference passes into a green circle, which is gradually diffused into a wide straw-yellow band, bounding the ecchymosis on every side, if it be in a free or loose part of the skin. In four, five, or six days, the dark livid colour slowly disappears from the circumference to the centre, while the coloured bands spread more widely around. A central dark spot may be perceived after ten days or a fortnight, and in a very extensive ecchymosis, it is some weeks before all traces of it are lost. The rapidity of these changes will be modified by circumstances, elsewhere stated. Observations of this kind often lead to useful results when proper caution has been taken. The appearance of a contusion inflicted recently before death, and of another inflicted some days before, is of course different, and by an appreciation of this difference, a person charged with murder may or may not be connected with one or the other period of infliction, or with both. In a case of alleged manslaughter, in which I was consulted some time since, there were found on the person of the deceased, the wife of a mechanic, the marks of severe bruises; some of them in the immediate neighbourhood of each other, had the rings of colour peculiar to a disappearing ecchymosis, while the others had not. The man alleged in his defence that he had only struck his wife once, a few hours before her death, whereas, the above medical facts proved not only that the deceased had been struck more than once, but that some of the blows must have been inflicted probably several days before her death. These inferences were corroborated by the evidence of an apprentice who had witnessed the assaults.

Such, then, is an outline of the facts which may occasionally enable us to say, how long before death particular injuries have been received; or to assign a probable period for their infliction on the living. By them we may be able to determine, whether two wounds found on a dead body, were or were not inflicted at or about the same time. The law in these cases, seldom requires a very close medical opinion; indeed this, it would be scarcely possible to give under any circumstances. If a medical witness can only state, about what time the injury was inflicted, circumstantial evidence will make up for the want of great medical precision or accuracy on the point.

How LONG DID THE DECEASED SURVIVE?—This question, it will be perceived, is indirectly connected with the preceding, although sometimes put with an entirely different object. Supposing the wound not to have been such as to prove rapidly fatal, the length of time which a person has survived its infliction, may be determined by noting whether it has undergone any changes towards healing, and in what degree. As a wound remains in the same state for about eight or ten hours after its production, it is not easy to say within this period, how long the person may have survived. Then it has been supposed, that a medical opinion might always be formed from the nature of the injuries, and the parts which it has involved. Thus, a wound may have involved large blood-vessels or organs important to life; in this case it is pretty certain that the individual must have died speedily. Let us, however, bear in mind, that these so-pronounced rapidly mortal wounds, do not often prove fatal for some hours or days; a fact which has been much overlooked by surgeons, although of considerable importance in relation to the medical jurisprudence of wounds.

Wounds of the carotid arteries are often pronounced *instantaneously* mortal. A witness may deliberately state that the person could not possibly have survived an instant. This is a very hazardous opinion, for it occasionally comes out on inquiry, that if such a wound were instantaneously mortal, then, in defiance of every rational probability, or of the strongest presumptive evidence to the contrary,—the deceased must have been murdered. A medical opinion of this kind has not only been refuted by circumstances, but by the evidence of eye-witnesses. The medical witness is then, perhaps, compelled to admit, that his rules for judging of the mortality of wounds are wrong, and that the person may have survived for a longer or shorter period. Formerly it was the custom to say, that every penetrating wound of the heart was instantaneously mortal, and that the person must have dropped down dead on the spot; but more accurate observations have shown, that this is an erroneous, and in medico-legal practice, a highly dangerous doctrine. If a man were found dead, and on inspection it was ascertained, that he had been stabbed through the left ventricle of the heart, it would probably be said in answer to a question relative to survivorship, that he must have died instantly. Yet it is well known, that the Duke de Berri, who was murdered in Paris in 1820, survived eight hours after having received a wound of this description. Other and more remarkable instances of survivorship will be adduced hereafter; in the meantime it may be stated, that, although in a surgical view, a question of this kind is of little importance, the case is very different in legal medicine. Upon it may depend the decision of questions relative to suicide, murder, or justifiable homicide.

These observations apply with great force to injuries of the head. Cases have been frequently brought into Guy's Hospital, where a patient who had received a blow on the head has survived several hours or days; and after death, such injury to the cranium has been found, as would, if the person had only been seen when dead, have probably given rise to a medical opinion, that he must have died instantly. On the other hand, a person may fall lifeless from a blow which would produce no appreciable physical changes in the cranium or its contents; yet in this case, if the facts had been unknown, it would have been said, the person might have survived some hours or days. Thus, then, we see that it is by no means easy to determine, from an examination of a wound in a dead body, how long the person actually lived after its infliction. I do not say that an opinion on this subject is never to be expressed from the nature and extent of an injury, but what should be impressed upon a medical jurist is, that it must not be hastily given; for a groundless suspicion of murder may be thereby excited against some innocent person. A wound may be mortal, but it by no means follows, that it should have destroyed life instantaneously.

As an illustration of the evil results of the practice of giving these hasty judicial opinions, I may take a case which to my knowledge has occurred twice under almost similar circumstances. A man is found dead in his chamber with his throat cut, and the incision is found to involve one or both carotid arteries. The medical inference is, that he must have fallen dead on the spot, and that he could not have survived an instant. If this be true, the weapon ought, of course, to be found either in the hand of the deceased or close to his body; but it is lying in another room, and there are marks of blood between the two rooms. What then is the conclusion? Either that the medical opinion is erroneous, and the deceased could not have dropped down dead instantly; or that he must have been murdered. This is, of course, a serious alternative, and unless circumstances tend to expose the error of the medical statement, irreparable injury may be done to an innocent person. The medical opinion has always given way when circumstances refuting it appeared; but it is the duty of a medical jurist to profit by such errors,—to apply his opinions with greater caution to similar cases, and not wait for their refutation by incontrovertible facts.

CHAPTER XXXVIII.

ACTS INDICATIVE OF VOLITION AND LOCOMOTION IN PERSONS MORTALLY WOUNDED.

THIS question is immediately connected with those considered in the preceding chapter. It is often a matter of serious inquiry, whether a person can perform certain actions, or move after receiving a wound which is commonly regarded as necessarily mortal, and likely to destroy life speedily. In respect to wounds of a less grave description, if we except those affecting the members directly, which will be hereafter examined, the power of willing and moving in the person who has received them, cannot be disputed. The best way of treating this subject, will be, perhaps, to select a few cases of severe injuries to important parts or organs, and which are usually considered to destroy life speedily.

The question relative to the power of exercising volition and locomotion, has been chiefly confined to those cases in which there were injuries to the head, wounds of the heart, the large bloodvessels, the diaphragm, and the bladder.

The following case occurred a few years since in the Norfolk and Norwich Hospital: A boy, owing to the bursting of a gun, had the breech-pin lodged in his forehead. He got out of a cart, in which he had been brought from a distance of four or five miles, and walked into the hospital without assistance. The pin was firmly impacted in the frontal bone about the situation of the longitudinal sinus. On its removal, a portion of brain came away with several pieces of bone, and the aperture in the cranium was nearly an inch in diameter. Symptoms of coma then came on, and the boy died in forty-eight hours. The brain was found to be considerably injured. (Med. Gaz. xviii. 458.)

Mr. Watson mentions a similar case. During a quarrel between father and son, the latter threw a poker at the former with such violence, that the head of the poker stuck fast in his forehead, and was with some difficulty withdrawn. The father asked those who were near him, to withdraw the weapon, and he was afterwards able to walk to the infirmary. He died from inflammation of the brain. (On Homicide, 62.)

A case occurred to Dr. Wallace, of Dublin, in which a man fell from a scaffold on the summit of his head. He was stunned by the fall, but on reaching the hospital, dismounted from the car which conveyed him, and walked up stairs with very little assistance. He died in three days, but he remained perfectly rational, and was enabled to get up and go to the water-closet the day before his death. On inspection, there was only a slight abrasion on the vertex, but the skull was found split into two nearly equal halves from the frontal bone backwards, through the sagittal suture to the foramen magnum. The longitudinal sinus was laid open throughout. In both hemispheres, there was a large quantity of effused blood in a semi-coagulated state; and more than two ounces were found at the base of the skull. (Lancet, April 1836.) Supposing this person to have been found dead with such extensive injuries, the medica opinion would probably have been, that he was not likely to have lived or moved afterwards; and yet the power of volition and locomotion remained with him for two entire days!

The medical opinion in an abstract question of this kind, is commonly based on individual experience; but the question really is, not whether the witness may himself have seen such a case, but whether such a condition of things is possible. If all opinions in a court of law were to be founded on individual experience, many medical facts important either to the prosecution or defence, would be lost because the witness by mere accident might never have met with an instance which presented them.

Dr. Cunningham, of Hailsham, mentions the case of a boy who met with an accident while firing a pistol. The pistol burst, and there was no doubt that the breech had entered the brain, although it could be nowhere perceived. The boy remained sensible for two days, and although some amendment took place, he died twenty-four days after the accident. The breech of the pistol, weighing nine drachms, was found lying on the tentorium; and the brain was much disorganized. (Lancet, July 1838.) In this case the boy was shot completely through the brain, a heavy mass of iron having traversed that organ, but he was not even rendered insensible by so serious a wound.

The importance of this question will be further seen by the following medico-legal case, reported by Dr. Wallace: A man was found dead in a stable, with a severe fracture of the temporal bone, which had caused the rupture of the middle meningeal artery. A companion was accused of having murdered him, but he alleged that the deceased had fallen from his horse the day before, and met with the accident. It appeared, however, that after the fall the deceased had gone into a public-house before he returned to the stables, and remained there some time drinking. The question respecting the guilt of the accused party rested upon the fact, whether, after such an extensive fracture of the skull with extravasation of blood, it was possible for a man to do what the prisoner had represented the deceased to have done. Dr. Wallace gave, very properly, a qualified opinion; he said it was improbable but not impossible, that the deceased could, after receiving such an injury, have gone and drunk at a public-house. The extravasation was here the immediate cause of death, and probably this did not take place to the full extent until after the excitement from drink.

It is easy to conceive many cases in which this question will be of material importance. For instance, a man may fall from a height and produce a severe compound fracture of the skull. He may, nevertheless, be able to rise and walk some distance before he falls dead. Under these circumstances there might be a strong disposition to assert, that the deceased must have been murdered :—the injuries being such that they could not have been produced by himself, there being at the same time no weapon near, and no height from which it might be supposed he had fallen.

Wounds of the heart were formerly considered to be immediately fatal to life, but this only applies to those wounds whereby the cavities of the organ are extensively laid open. Persons who have sustained wounds of the heart, have lived sufficiently long to exercise the powers of volition and locomotion.

Mr. Watson met with a case where a man who had been stabbed in the right ventricle, ran eighteen yards after having received the wound. He then fell, but was not again able to rise; he died in six hours. On dissection, it was found that a punctured wound had extended into the right ventricle in an obliquely transverse direction, dividing in its course the coronary artery. The pericardium was nearly filled with blood, and about four pounds were extravasated on the left side of the thorax. (On Homicide, 98.)

One of the most remarkable instances of the preservation of volition and locomotion after a severe wound of the heart, will be found reported in the Medical Gazette, (xiv. 344.)

In this case, the patient, a boy, survived five weeks, and employed himself during that period in various occupations. After death, a mass of wood was found lodged in the substance of the heart. Had he been found dead with such an injury, it is most probable, the opinion would have been that his death must have been instantaneous.

In these cases, little or no blood probably escapes in the first instance, but it may afterwards continue to ooze gently, or suddenly burst out in fatal quantity. It must not, therefore, be supposed when a person is found dead, with a wound of the heart, attended with abundant hæmorrhage, either that the flow of blood took place in an instant or that the person died immediately and was utterly incapable of exercising any voluntary power. Only one circumstance will justify a supposition of this kind; namely, where the cavities of the organ, more especially the auricles, are largely laid open. The following case reported by one of the editors of Beck's Medical Jurisprudence, will show the importance of this medico-legal question. It was here material to the defence of the prisoner.

The keeper of a brothel was tried in Glasgow, in the year 1819, for the murder of a sailor, by shooting him through the chest. It appeared from the evidence of the medical witnesses that the auricles and part of the aorta next the heart, were "shattered to atoms," by the slugs and brass nails with which the piece was charged; and in their opinion, the deceased must have dropped down dead on the moment that he received the shot. The body was found in the street, and the door of the prisoner's house was *eighteen feet* up an entry: so that it followed, if the medical opinion were correct, that the prisoner must have run after the deceased, and have shot him in the street. For the prisoner it was urged and proved, that he had shot the deceased through the door of his own house, which the latter was attempting to enter by force. Besides direct testimony to this effect from those within the house, and from a lad who was with the deceased at the time, it was proved that there was a stream of blood from the door of the house to the spot where the body lay, which could not have flowed from the body towards the house, as the threshold of the door was on a higher level than the pavement of the street. On this evidence, the prisoner was acquitted.

If, by the heart being "shattered to atoms," we are to understand that its cavities were entirely laid open, and its substance destroyed, we have a description of wound which most professional men would not hesitate to pronounce instantaneously mortal. Although nothing is stated on the point, yet we must suppose it was proved, before the question of survivorship was raised, that the body of the deceased could not have been dragged after death from the door of the prisoner's house, to the spot where it was found; a circumstance which would have sufficed to account for the presence of a stream of blood, notwithstanding the difference of level between the street and the door of the house. The question was of importance to the prisoner, inasmuch, as if he had shot the deceased while the latter was endeavouring to break into his house, the homicide might have been regarded as excusable; but, if after the deceased had left the house, he had run into the street and shot him, then probably this would have been considered sufficient evidence of malice to have justified a verdict of wilful murder. The jury adopted the first view of the case; and, therefore, found that the deceased had actually run into the street, after having been shot through the door of the prisoner's house.

This question relative to the power of locomotion, perhaps more frequently occurs with respect to wounds of the great blood-vessels of the neck, than of the heart,—suicide and murder being more commonly perpetrated by this means. Among the facts connected with this subject are the following:

In April, 1842, a man named Cook, living at Bristol, cut the throat of his sister, and afterwards committed suicide by cutting his own. The woman was found lying dead in the garden at some distance from the house, while it was obvious, from the weapon and a quantity of blood being found near a chair in the kitchen, where she was in the habit of sitting, that the wound must have been inflicted there. On an inspection it was ascertained that the right carotid artery and jugular vein, with the trachea and œsophagus, were completely divided; yet this woman had been able to escape from the house. The matter excited some astonishment at the inquest, from its being supposed that all such wounds ought instantly to deprive a person of the power of moving.

This question also became a subject of judicial examination, in the case of the King against Danks, who was tried for murder at the Warwick Lent Assizes, 1832.

On the evening on which the murder was committed, the prisoner and the deceased were seen to proceed together to a hovel by the side of a public road. Cries of distress were heard, and between eight and nine o'clock the next morning, the body of the deceased was brought home, having been found lying in the road, at a distance of twenty-three yards from the hovel. From the quantity of blood found in the hovel it was evident that some one had been severely wounded there. The blood was traced from this place to a gate, some yards from it on the road-side, and over that gate to the spot where the deceased lay. The prisoner was speedily apprehended, and on his clothes were found some marks of blood. On his being committed to gaol after the inquest, he made the following confession to a constable. He said, that he and the deceased had walked together to the hovel, and were there for about a quarter of an hour, when he knocked her down by striking her on the temple. He fell on her back, and held her under him: he cut her throat, but this did not prevent her crying; he cut her again, and then she ceased crying, so that he thought she was dead. He then left the place, got over the gate, and went up the road. When about one hundred yards from the hovel, he thought he heard the footsteps of a man coming after him, but upon turning round he saw nobody.

The evidence respecting the condition in which the body was found, was as follows. The constable deposed, that when he came to the spot, he perceived the deceased lying on her face with one arm under her; it was impossible for any one, as the body lay, to see that the throat was cut. The deceased's cap was off her head, and part of it stuck to the blood on her face. There was a large quantity of blood on the straw in the hovel;—there were marks of blood on the wood-work at the side of the hovel, and also from this to the gate. On the bars of the gate, there was a quantity of blood; and on the topmost bar were marks, as though it had been pressed by a heavy hand. The evidence of a surgeon who was called to see the body, was to the effect, that he found at the upper part of the throat, near the left angle of the jaw, a gaping incised wound, about seven inches in length and three in depth. It extended posteriorly to the commencement of the œsophagus, and passed obliquely down the right side of the neck as far as the fourth cervical vertebra. The trunk of the carotid artery and all the principal branches of the external carotid, with the jugulars, were divided; and, in his opinion, such a wound must have occasioned death immediately, or within a very short time,—so short, as to render it highly improbable, but not impossible, that the woman could have gone the distance of twenty-three yards, besides getting over the gate, in that dreadful condition. There was another incised wound, two inches below the former, in front of the throat, but not deep enough to divide the trachea;—with that wound alone, the witness admitted, the deceased might have been able to reach her home. The evidence of this gentleman, as to the nature of the wounds and the almost utter impossibility of the larger one having been inflicted in the hovel, was given before the prisoner's voluntary confession. The prisoner was found guilty of the murder and executed. (Med. Gaz. x. 183.)

The following additional particulars were subsequently ascertained. The wound first inflicted by the prisoner was quite inconsiderable; it was situated at the lower part of the neck, within an inch of the clavicle, and was very superficial; the integuments were merely cut through, and the cartilage of the trachea was scarcely grazed. From such a wound, the quantity of blood in the hovel could not possibly have flowed. On the other hand, there would have been from the second and more severe wound, a most copious flow of blood, which must have been thrown off by the prominence of the deceased's abdomen to the side of the hovel, as she passed along to the gate; then on the gate a similar transfer of blood was manifest, and there were the marks in blood of both her hands. The prisoner's hand was also marked on the gate, but at a different place. From several trials, it was determined that it took from fifteen to twenty seconds to pass from the hovel, where the wound was alleged to have been inflicted, to the spot where the body was found. The obstruction of the gate, which was three feet ten inches in height, was considered to be equivalent to eight or ten yards more. There was scarcely any blood between the gate and the place where the body lay; but this was accounted for on the probable supposition, that in running, the deceased had closed the wound with her cap,—at the same time, perhaps, assisting this closure by holding down her head. A large quantity of blood had flowed down the fore part of her body, and had lodged about the lower part of the abdomen, a fact which seems to show that she must have been in the erect posture, either when it was inflicted or afterwards. Much blood had also been absorbed by the under garments. But, in estimating the time that elapsed from the infliction of the wound, till the unfortunate woman dropped, supposing it to have been inflicted in the hovel, there are other circumstances which require to be taken into consideration. We cannot conceive that the deceased rose to run away on the instant she received the wound,—she may have lain several seconds, at least until the prisoner himself had left the hovel, and several more may have passed before she could have risen from the ground. Lastly, it may be added, that the prisoner declared, to the hour of his execution, that he never touched the woman except in the hovel where he left her for dead.

Such, then, are the particulars of this singular case. From a careful review of the facts, however contrary to ordinary experience the admission may appear, we are constrained to admit, that the deceased actually survived a sufficient length of time to run the distance described. We can only deny this by disbelieving the facts; for, independently of the prisoner's declaration, the quantity of blood found in the hovel was such that it could not have proceeded from the superficial wound at the lower part of the neck, but must have come from some considerable vessels. Now if, with the knowledge of this circumstance, it be supposed that the mortal wound was inflicted on the spot where the deceased's body lay, still the difficulty is rendered greater, because then the deceased must have run to the hovel to have bled, and back again. Nor can we imagine that her body was conveyed after death from the hovel to the place where it was found by the prisoner, since the marks of her hands on the gate show that she must have been living at the time; besides there could be no possible motive for the prisoner carrying her either living or dead, twenty-three yards on the road. In short, no explanation will suit the circumstances, but that which allows that the deceased actually exerted her powers of volition and locomotion.

The following case of voluntary locomotion after a severe wound, was communicated to me by a friend. It will be seen that the distance traversed, was much less. In October, 1833, a man committed suicide while walking along Oxford-street, by cutting his throat with a razor. After having inflicted the wound, he was observed to hold a handkerchief to his neck, and run forwards. He fell dead on the pavement, having run about four yards from the spot where he wounded himself. The razor was found firmly grasped in his hand. On an examination of the body, it was ascertained that the carotid artery and several of its branches, with the jugular vein on one side, as also the trachea, had been completely cut through. The surgeon gave it as his opinion, at the inquest, that from the character of the wound, the deceased must have fallen dead on the spot; and, although it was possible that he might have run so far as stated after the infliction of the wound, yet such a circumstance would be quite unusual. The truth is, questions of this nature, like those relating to the mortality of wounds in general, are only to be decided by reference to a very enlarged sphere of experience. Cases like these may be rare; but still they prove that we should be very guarded in denying that acts indicating volition and locomotion, have been performed by a deceased party, however severe the wound which has been the cause of death.

There is one circumstance which requires to be mentioned in relation to these severe wounds in the throat, namely, that although the person may have the power of locomotion, he may not be able to use his voice so as to call for assistance. It sometimes excites surprise at an inquest, how a murder may in this way be committed without persons in an adjoining room hearing any noise;—but the fact is well known medically, that when the trachea is divided, as it frequently is on these occasions, the voice is lost.

A rupture of the diaphragm has been considered sufficient to deprive a person of the power of locomotion:—but there appears to be no good ground for this opinion. The general effect of such an accident may be to incapacitate a person; but the question is put to a medical jurist, as to the possibility of a wounded party being able to move after the injury. In the following case, reported by Devergie, the answer was material:

An intoxicated man, after having been maltreated by another, returned home, walking for at least two hours with two companions. The man died in fifteen hours; and, on inspection, among other severe injuries, there was found a recent longitudinal rupture of the diaphragm about two inches and a half in extent, and the stomach protruded through the aperture. The question was,—When could this rupture have taken place, for it was undoubtedly the cause of death? Was it possible for a person, with a recent rupture of the diaphragm, to walk for two hours? If this power of locomotion were admitted, then it followed that it might have been caused by the man who first ill-treated the deceased;—if not, then that the injury had been probably caused by the deceased's two companions, for it did not appear that he had been in company with any other person. The medical witness admitted the possibility of the deceased being able to walk under the circumstances, but he thought it very improbable. There was not the smallest evidence to show that the deceased had been attacked or beaten by his two companions in journeying homewards; and, therefore, there could be no just reason for inferring their guilt, simply because locomotion after such an injury was something unusual as a matter of medical experience.

In ruptures of the bladder, attended with extravasation of urine, the same question as to the existence of a power of locomotion, has arisen. By the answer to this, we may sometimes determine whether the rupture was the result of homicide or accident. The following cases will show that this power does exist in some instances, although the general result is perhaps to incapacitate the individual from moving.

A man, aged thirty-one, while intoxicated, received a blow on the lower part of his abdomen. He was sobered by the accident, and walked home a distance of a quarter of a mile, although suffering the greatest agony. When seen in the evening, twelve ounces of bloody urine were drawn off by a catheter, and he complained of having felt cold immediately after he had received the blow. He died four days after the accident. On inspection, there was no mark of bruise or ecchymosis on any part of the abdomen. The bladder was ruptured in its upper and posterior portion for about an inch. (Lancet, May 14, 1842.) The second case was related to me by a pupil. A gentleman who had been compelled to retain his urine, fell accidentally in descending a staircase, with the lower part of his abdomen against the edge of one of the steps. The sense of fulness in his bladder immediately ceased, and he walked to a friend's house to dinner. The nature of the accident was mentioned to a surgeon there present, who immediately suspected that the bladder must have become ruptured. This case terminated fatally in twenty-four hours. Thus then from these two instances, it is evident that locomotion and muscular exertion may take place after an accident of this description.

The medico-legal relations of this subject will be apparent from the following case, reported by Mr. Syme. A man passed some hours convivially with a few friends, after which a quarrel ensued, blows were exchanged, and the parties wrestled with each other. The deceased then walked home, a distance of more than a mile; and in crossing the threshold of his own door, he fell forwards on his abdomen. When lifted up, he complained of great pain, and was put to bed, being quite unable to exert himself. He died in two days, and upon dissection the bladder was found ruptured at its fundus to the extent of between two and three inches. Under these circumstances it became a question whether the rupture was caused by the violence of his companions, or by the accidental fall at the door of his own house. If by his companions, he must have walked more than a mile with his bladder ruptured; but two medical witnesses declared that he could not have walked this distance after the rupture, and consequently that it must have been occasioned by the subsequent fall. The symptoms of rupture and extravasation occurring immediately after the fall, rendered it highly probable that this was really the cause. At the same time it is obvious that the power of locomotion may be exerted under such circumstances to a much greater extent than is commonly supposed.

Under many severe accidents, this power of moving, if not exerted to a large extent, may take place in a small degree, and this is occasionally an important question in legal medicine. Thus it must not be lost sight of, when we are drawing inferences as to the relative position of a murderer and a murdered person from the situation in which the body of the deceased is found. A dead man, with a mortal injury to the head or heart, may be found lying on his face, when he actually fell upon his back, but still had had sufficient power to turn over before death, or he may have fallen on his face, and have afterwards moved, so that the body may be found lying on the back. A slight motion of this kind is very easily executed,—it does not always depend on volition. Individuals suffering under severe concussion, have been frequently known to perform acts unconsciously and automatically.

The foregoing cases may perhaps be considered rare and as exceptions to the general rule. The medical jurist must bear in mind, however, that he is not requested to state in how many out of a given number of individuals similarly wounded, this power of performing acts indicative of volition and locomotion may remain; but simply whether the performance of these acts be or be not possible. It is on this point only, that the law requires information. The hypothesis of guilt when we are compelled to judge from circumstances in an unknown case, can only be received by an exclusion of every other possible explanation of the facts. As a matter for surgical prognosis or treatment, such cases, from their rare occurrence, may have little influence; but in legal medicine, the question is widely different. Facts, however rare, here admit of a very important and unexpected application.

Although in cases of severe wounds, we may allow it to be possible that persons should survive for a sufficiently long period to perform ordinary acts of volition and locomotion, yet the presence of a mortal wound, especially when liable to be accompanied by great hæmorrhage, must prevent all struggling or violent exertion on the part of the wounded person,—such exertion we must consider to be quite incompatible with his condition. In this way, a medical jurist may be sometimes able to determine whether a mortal wound found on the deceased, have been inflicted for the purpose of murder, or in self-defence, as the following case reported by Mr. Watson will show.

A man was tried at the Lancaster Assizes in 1834, for the murder of a woman at Liverpool, by stabbing her in the chest. Prisoner and the deceased, with two other females, were quarrelling in the passage of a house. A struggle ensued between the prisoner and deceased, which one of the witnesses said lasted for ten minutes. When the prisoner had reached the door, he pulled out a knife and stabbed the deceased in the chest. She fell and died almost immediately. The prisoner alleged that he was attacked by several persons, and that he stabbed the woman in self-defence. The judge said, if the blow had been struck with premeditation before the struggle, the crime would be murder;—if during the struggle it would be manslaughter. The medical evidence showed that the blow could not have been struck before the struggle, because it was of a speedily mortal nature, and the deceased would not then have been able, as it was deposed to by the witnesses, to struggle and exert her strength with the prisoner for *ten minutes* afterwards. This being the case, it followed that in all medical probability the deceased actually received the blow towards the conclusion of the quarrel; and therefore it might have been inflicted while the prisoner was attempting to defend himself. The jury returned a verdict of manslaughter.

CHAPTER XXXIX.

ON WOUNDS AS THEY AFFECT DIFFERENT PARTS OF THE BODY.

There are numerous medico-legal questions connected with wounds, as they affect different parts of the body, which now call for examination. It will not be necessary to enter into any surgical details respecting them; but an investigation of the symptoms caused by wounds of different structures, is of importance in legal medicine. It is only by attention to these that a correct prognosis can be given; and, when death is not a speedy result, the treatment of a prisoner by a magistrate, will materially depend upon the prognosis of the medical practitioner. By far the most important questions arise where death has taken place after a severe injury, but under circumstances which render it doubtful whether the fatal event can be fairly ascribed to the injury or not. This subject has been already considered in relation to wounds in general; but it was then impossible to specify all the modifications that are liable to present themselves according to the particular part of the body affected. The danger of wounds, and their influence in causing death, are then the two principal points to which the attention of a medical jurist must be directed.

WOUNDS OF THE HEAD.—Incised wounds, affecting the scalp, rarely produce any serious effects, but this will, of course, depend on their extent. When the wound is contused, and accompanied by much laceration of the integuments, it is highly dangerous, in consequence of the tendency which the inflammatory process has, to assume the erysipelatous character. The results of these wounds are, however, often such as to set all general rules of prognosis at defiance. Slight punctured wounds will sometimes terminate fatally in consequence of inflammation being set up in the tendon of the occipito-frontalis, followed by extensive suppuration beneath; while, on the other hand, a man will recover from a lacerated wound by which the greater part of the integuments may have been stripped from the bone.

There are two sources of danger in wounds of the scalp: 1. The access of erysipelatous inflammation. 2. Inflammation of the occipito-frontalis tendon, followed or not by the process of suppuration. Either of these secondary effects may operate fatally in slight or severe wounds. Neither can be regarded in the light of an unusual consequence of a severe wound of the scalp: but when one or the other follows a very slight injury, there is reason to suspect that the patient may have been constitutionally predisposed; and if fatal effects follow, the influence of this predisposition should be considered as a mitigatory circumstance. Bad treatment may likewise lead to a fatal result from a wound, not regarded as serious in the first instance; but how far the responsibility of the aggressor would be affected by a circumstance of this nature, has been treated of in another place. (p. 350.)

Wounds of the head are dangerous, in proportion as they affect the brain; and it is rare that a severe contused wound is unaccompanied by some injury to that organ. There is, however, a difficulty which the practitioner has here to contend with, namely: that it is scarcely possible to predict from the external wound, the degree of mischief which has been produced internally. These injuries, as it is well known, are very capricious in their after-effects: the slightest contusions will be attended with fatal consequences, while fractures, accompanied by great depression of bone, and an absolute loss of substance of the brain, are sometimes followed by perfect recovery. Another difficulty in the way of forming a correct prognosis, consists in the fact, that an individual will recover from the first effects of an injury, but after a short time, he will suddenly die; and on examination of the body, the greater part of the brain will be found destroyed by the suppurative process, although no symptoms of mischief may have manifested themselves until within a few hours of death.

CONCUSSION.—The common effect of a violent contusion on the head is to roduce concussion or extravasation of blood, or both. In concussion, the symptoms come on at once, and the patient, if severely affected, sometimes dies without any tendency to reaction manifesting itself. But the period at which death takes place is liable to vary: a man may die on the spot, or he may linger in a state of insensibility several days, and in either case, after death, no particular morbid change may be discovered: there may be simply abrasion of the skin.

The state of insensibility observed in concussion, is sometimes only apparent. Mr. Guthrie relates the case of a gentleman who while lying apparently deprived of sense and motion, and supposed to be dying, heard a discussion between a relative and another person, as to how they should dispose of his body, and he was conscious of his utter inability to make any movement, indicating that he was alive and understood their conversation. Inflammation may supervene after the primary shock, suppuration will take place, and the patient die after the lapse of some weeks or even months. It is important in a medico-legal view to notice, that an individual may move about and occupy himself, while apparently convalescent, for a week or ten days after recovery from the first shock, and then suddenly be seized with fatal symptoms and die. This apparent recovery leads to the common supposition, that death must have been produced by some intervening cause, and not by violence to the head, —a point generally urged in the defence of such cases. When the inflammation that follows concussion is of a chronic character, the person may suffer from pain in the head and vomiting, and die after the lapse of weeks, months, or even years. (antè, p. 348. Case by Sir A. Cooper.) A case is mentioned by Hoffbauer, where the person died from the effects of concussion of the brain, as the result of an injury received eleven years before. (Ueber die Kopfverletzungen 57, 1842.)

The symptoms under which a wounded person is labouring, may be sometimes attributed to intoxication, and a medical witness may be asked what difference exists between this state and that of concussion.

The history of the case will suffice to establish a distinction, but this cannot always be obtained. It is commonly said that the odour of the breath will detect intoxication; but it is obvious that a man may meet with concussion after having drunk liquor insufficient to cause intoxication, or concussion may take place while he is intoxicated, a combination which frequently occurs. Under such circumstances, we must wait for time to develope the real nature of the case; but concussion may be so slight, as sometimes closely to resemble intoxication; and in the absence of all marks of violence to the head and the existence of a spirituous odour in the breath, the medical examiner might be easily deceived. Or, on the other hand, intoxication may be so great as to give rise to the apprehension of fatal consequences, and the co-existence of a mark of violence on the head, might lead to error in the formation of an opinion. What is the line of conduct to be pursued on such occasions? The examiner should weigh all the circumstances, and if there be one cause for the symp-

Blood may be found extravasated in various situations within the interior of the cranium: and the cause of the extravasation may be either disease or violence. The skill of a medical jurist is often required to determine which of these causes is the more probable, as where, for instance, a pugilist has died after having received severe injuries to the head, and his adversary is tried on a charge of manslaughter. On these occasions, it is often urged in the defence, that the fatal hæmorrhage might have arisen either from a diseased state of the vessels of the brain; or, if the evidence render it probable that the blow was the cause, that the effects of the blow were aggravated by a diseased state of the vessels, or by the excitement into which the deceased was thrown, either from the effects of intoxication or passion. When the brain is not lacerated by the violence, the blood is effused on the surface of or between the membranes or at the base. It is not always seen under the spot where the blow was inflicted, but often by counter-stroke on the surface of the brain, directly opposite to it;—a case which a medical witness has frequently had to explain on trials, and which depends on the same cause as fracture by counterstroke, to be hereafter spoken of. Effusions of blood from a diseased state of the vessels, more commonly take place in the substance of the brain, but they sometimes occur on the surface of the organ from mere excitement or over-exertion of the muscular powers. In a case which occurred in 1840, a boy, aged twelve, died suddenly, with comatose symptoms, after violent exertion. On inspection, half a pint of blood was found effused on the surface of the brain. (Lancet, Nov. 1840.) This case is the more remarkable, because it is rare that spontaneous effusions from disease should occur in so young a subject. Then again it must be remembered, that under the effects of violence where the brain participates in the injury, blood may be effused in its substance so as to resemble cerebral hæmorrhage from disease. Thus when the skull has sustained violent blows without fracture, the extravasated blood has been observed to proceed from the minute vessels of the pia mater and choroid plexus.

If the effusion depends on disease, the arteries around may be found in a diseased condition, or the brain itself may be found softened and disorganized. The state of the brain and its vessels should be closely examined in all cases of alleged violence; since hæmorrhage may take place from excitement, or slight blows, whenever this diseased condition exists. It has occasionally happened, but more especially in old persons, that the individual has dropped down dead without a blow being struck, and that death has been wrongly imputed to violence. Cerebral hæmorrhage from disease rarely occurs in persons under forty years of age. Frequent intemperance and violent passion may easily create a tendency to it in younger subjects. As an effect of violence it may take place in persons of all ages. For a very full account of the circumstances accompanying extravasation from violence, see Brach's Chirurgia Forensis Specialis, 63. Köln, 1843.

Another condition besides intoxication and passion has been said to favour a rupture of vessels and an effusion of blood on the brain,—namely, a thickened state of the parietes of the left ventricle of the heart. According to some pathologists, this morbid condition favours the occurrence of cerebral hæmorrhage, by the force with which the ventricle propels the blood to that organ. Unless the brain be softened and the vessels diseased, this condition of the heart is not likely to have any notable influence.

As a summary of these remarks, we may say that in extravasations from violence,—the blood generally issues from a vessel which is plainly seen to be torn, as the middle meningeal artery or lateral sinus :—it is commonly found on the surface of the brain, and not in its substance, unless the organ be lacerated. When placed between the dura mater and skull, more especially when immediately below the seat of violence, or directly opposite to it by counterstroke; this is strong evidence, cæteris paribus, that it has proceeded from a blow. When there is a fracture of the skull, the presumption of the extravasation being due to violence is great; because this is not only a sufficient, but a very obvious cause, while the idea of its having proceeded from disease only, is remote and speculative. When, besides these points, there is no remarkable congestion of the brain in other spots,—the substance of the organ is firm, and the vessels are, to all appearance, free from disease, we have the strongest reason to presume, that the extravasation must have been due to violence, and to no other cause whatever.

The evidence given on some trials, where the main question has turned upon the cause of an extravasation of blood in a person who has sustained violent injuries to the head, has rather tended to reflect disgrace on medical science. It has been made to appear, either directly or by implication, that no sort of mechanical violence applied to the head of a man in a state of drunkenness or passion,—of one whose cerebral vessels were probably diseased,—or the parietes of whose heart might be thickened,—could have had any effect in producing the fatal extravasation found in the head after death. In spite of an individual having received a violent blow with a bludgeon, sufficient to have killed a stout and vigorous man,—or of his having been thrown with considerable force with his head against a stone floor, an unrestricted admission is often made, that excitement alone, or drunkenness alone, would account for the extravasation without reference to the blow. In putting the most favourable construction upon these cases, when we have clear evidence of some violence having been used to the head with the presence of the usual post-mortem appearances, our opinion should be that the excitement or drunkenness had predisposed to, but was not the immediate cause of the cerebral hæmorrhage. There seems to be no good reason for assuming that apoplexy from natural causes always occurs, by a peculiar coincidence, just at the time that a person receives a violent blow with a bludgeon on the head, or for giving to the assailant the benefit of this hypothetical explanation.

When engaged in the investigation of a case of this kind, it is always a fair matter of inquiry, whether the violence, upon the evidence, was not of itself sufficiently great to account for the extravasation of blood without the supposition of co-existing disease or excitement. Even if it be admitted, that the rupture of a blood-vessel and extensive extravasations on the brain may take place from simple excitement and passion; yet this is an event comparatively rare, at least in the young and healthy, while nothing is more common than that these effects should follow violent injuries to the head, whatever the age or condition of the person. The medical witness should remember that, on these occasions, if he is unable to say positively whether the extravasation were due to the excitement or the blows, he will satisfy the court if he only state clearly that which is, in his own mind, the more probable cause: and by weighing all the circumstances of the case accurately before-hand, he will scarcely fail to find, at least in many instances, that one cause was more probable than the other. Thus, if a man, excited by passion and intoxication, is struck on the head, and the blow is very slight,—such as an unaffected person would probably have sustained without injury; yet in this case insensibility and death follow, and, on examination, a quantity of blood is found extravasated in the substance of the brain,—Can it be a matter of doubt with the practitioner, that the extravasation was chiefly due to the excitement under which the deceased was labouring? To take a converse instance,—a man, moderately excited in a personal conflict with another, is struck most violently on the head, or falls with great force on that part of the body,—this is followed by fatal extravasation on the surface of the brain, and it would be no unexpected consequence of such violence that a similar appearance should be met with in an individual calm and unexcited,—can the practitioner hesitate to say that, in this instance, the blow would satisfactorily account for the extravasation, without reference to any co-existing causes of excitement? These may be allowed to have their influence in giving an increased tendency to cerebral hæmorrhage or in aggravating the consequences of the blow, but no further.

In these criminal investigations, when a witness is examined in chief, he asserts, perhaps, that the extravasation of blood was owing to the blow inflicted on the head. He is then asked by the counsel who cross-examines him, whether vessels may not be ruptured by excitement: he answers at once in the affirmative, thus unconsciously producing an impression on the minds of the jury, that excitement may have caused the rupture of the vessel in the particular case on which he is being examined. This is precisely the sort of answer which a prisoner's counsel wishes to extract from a witness; and the effect produced by it on the court, may not be always removed, even by a careful re-examination. The counsel for the defence is well aware that, in a case of this description, his only chance of obtaining an acquittal, is to throw a degree of doubt on the medical evidence; and to render it probable to a jury, that the death of the deceased party was due to some other cause than the blow inflicted by the prisoner. It may be very proper that a skilful barrister should exercise his talents in this way, but it is at the same time no more than just that a medical witness should be forewarned and forearmed for the kind of examination which he is about to undergo. The manner in which it appears to me, a witness so situated should conduct himself, is, that he should give a qualified answer to what is really a general question; and, supposing his opinion to be already formed on the subject on which he is giving evidence, he should not, unless it be strictly consistent with his own views, allow his answer to a general question to be made applicable to a particular case. If then asked, in cross-examination, whether vessels might not be ruptured and blood extravasated by excitement, he should answer that such an effect might undoubtedly follow: but that it was his opinion,—and I am here supposing that this opinion has been founded upon a deliberate examination of all the medical facts,—that excitement was not the cause of rupture and extravasation in the case in question. A witness has, it appears to me, a right to insist that his evidence shall pass to the jury without having any designed ambiguity attached to it. It may be said that the remedy for an evil of this kind is the re-examination of the witness; but I am satisfied from the reports of many cases before me, that the point is often overlooked. Besides one cannot understand why a piece of sophistry and equivocation is to be left to a chance exposure:—the case would then rest not upon sound medical evidence, but upon the relative degree of ingenuity and ability displayed by the counsel for the prosecution and defence.

In a trial for manslaughter which recently took place at Derby, it was proved that the prisoner and deceased had been wrestling. The prisoner had thrown the deceased with his bead on a stone-floor; he then seized him by the throat, and beat his head several times against the floor. The deceased died nineteen hours afterwards. On inspecting the body a great quantity of coagulated blood was found beneath the scalp. There was a wound over the right parietal bone, an inch and a half in length, penetrating through the scalp; but no fracture of the skull. There was a quantity of extravasated blood on the opposite or left side of the head; and a rupture of some branches of the carotid artery on the inside of the skull. On the neck were two discolourations to the left of the trachea, apparently occasioned by the pressure of two fingers. The laying hold of the neck might, in the opinion of the witness, have more readily caused a rupture of the cerebral vessels, by preventing the return of blood. The surgeon, after giving this description of the post-mortem appearances, was asked whether, in his opinion, death was occasioned by the injury proved in evidence. He said death might or might not have been occasioned by it. Death might have arisen from other causes,—an apoplectic fit might have occasioned it. The effusion of blood had occasioned death, and he had seen blood in the heads of many persons dying from apoplexy. The cause of death was the pressure of coagulated blood upon the brain. He was not able to speak to the cause of the rupture of the vessels. He thought it highly probable that the injury received was the cause of death,—it was certainly sufficient to account for it. The judge severely censured the witness, for not stating at once that he believed the injury was the cause of death. It is not mentioned whether the man was found guilty upon this evidence, or whether the jury acquitted him. (Med. Gaz. vii. 382.)

Mr. Amos, who reports this case, in commenting upon the medical evidence, observes—"The witness might have said the blows were a sufficient cause to have accounted for the death; but that apoplexy also, brought on by great excitation and drunkenness, was a sufficient cause, and the appearances within the head, would be the same from either (which of the two, however, was the more likely cause, under the circumstances, to have occasioned death, is not so much a medical question as an inference to be drawn by the jury from the evidence of the witnesses;) the utmost the surgeon could say, would be—here is a cause sufficient to account for death: still death might have been occasioned by another cause; and whether that other cause existed or not, it is quite impossible for me to say."

Let it be granted that excitation and drunkenness will produce apoplexy, and that the post-mortem appearances in the head will be the same whether death ensue from apoplexy or from blows: still, can any surgeon hesitate to admit, that the evidence in the above case proves that the violence was not merely the most probable, but the immediate cause of death? A man is forcibly thrown with his head on a stone-floor,—his head beaten several times against the floor, after he has fallen; and this violence has sufficed to produce a lacerated wound of the scalp, with considerable extravasation of blood beneath. But to explain the extravasation internally,—are we to suppose that the deceased is about this period seized with apoplexy, in consequence of his having been drunk and excited, and that this as satisfactorily accounts for death as blows on the head? Let us imagine that, instead of a trial for manslaughter, it had been a trial for murder: it is proved, in evidence, that the deceased was drunk and much excited,—the prisoner maliciously and without provocation, throws the deceased with his head on a stone-floor, then beats it violently against the floor: symptoms of cerebral disturbance come on, and the man dies in twenty hours. Serious marks of violence are found on the skull, and extravasation is met with in the brain after death. Could any surgeon conscientiously say that apoplexy was as sufficient a cause of death, in such a case, as the violence? Or if he did, is it likely that any court of justice would acquit a prisoner of having occasioned the death of the deceased upon so remote and hypothetical an explanation? The fact is, there are some cases of this description, in which all probability may become violated; and it is surely not to be admitted that a witness is ever justified in suggesting to the court at the same time, a probable and an improbable cause of death. To take, what appears to me to be a parallel instance: A man is proved to have had arsenic administered to him,—he dies under symptoms of acute gastritis, and, after death, the stomach is found inflamed. Would any medical witness, with a knowledge of the effects of arsenic, and that arsenic had been taken in the case in question, be justified in swearing that idiopathic acute gastritis might have supervened, and that it was as sufficient a cause of death and the morbid appearances, as the arsenic proved to have been taken? Or we will suppose the poison administered to have been opium, and the individual, of apoplectic diathesis, to die comatose, the brain presenting the appearances seen in apoplexy;—is it for the surgeon, in such a case, to suggest to the court, that death might be as satisfactorily accounted for by the simultaneous occurrence of apoplexy from disease, as by the poison which the prisoner administered? It appears to me that if he were to give such evidence in either of these instances, he would gratuitously throw ambiguity upon what in itself was sufficiently clear.

In reference to the case of manslaughter, just now quoted, it may be asked—Was not the violence sufficient to cause death under the same symptoms and post-mortem appearances within the same period of time, in an individual perfectly sober and unexcited? This question, I apprehend, would undoubtedly be answered in the affirmative by a reflecting surgeon, whatever opinion he might otherwise entertain respecting the possible aggravation of the symptoms and increased tendency to extravasation from excitement and drunkenness. Again, is it at all probable, that the drunkenness and excitement, without the violence, would have been sufficient to cause death, under the same symptoms and post-mortem appearances, and within the same period of time? If, as I apprehend it ought to be. this question were answered in the negative, the course which a medical jurist should pursue in these investigations will be at once apparent. The advice given by Mr. Amos, that the witness should state to the court "that although the cause mentioned was sufficient to account for death, still the death might have been occasioned by another cause," is of course only applicable to those cases, in which, without any violent medical improbability, death may have proceeded from either.

Professor Amos states, that "which of any two causes is the more likely, under these circumstances, to have occasioned death, is not so much a medical question, as an inference to be drawn by the jury from the evidence of the witnesses." With all deference to the opinion of the learned barrister, it appears to me that the determination of the probable cause of death in every case is a purely medical question, and one which, in disputed cases, can never be solved except by medical skill and experience. When two causes of death co-exist in a wounded body, and it is doubtful whether death was occasioned by the act of the prisoner, or by some other cause, then this forms a question of fact for the jury. But when, in the judgment of a practitioner, the cause of death is not doubtful, it can no longer be a question 'for the jury, although they may disbelieve the medical evidence, and return a verdict directly opposed to it. In proceeding upon any other principle, it may be inquired,—What would medical evidence become, if it were not in the province of the witness to ascertain which has been the more likely cause of death? Or why are surgeons summoned on trials for murder and manslaughter, unless to guide a jury in subjects on which they cannot possibly be informed? Such appears to be the opinion of some of our best legal authorities on evidence. (Starkie on Evidence, vol. ii. p. 946.) It is not hereby implied that a medical witness is to dictate to a jury the verdict which they are to return. When there is a doubt on his mind, he leaves the decision to them; but when there is no doubt on his mind, he plainly states as much, without being in the least influenced by the decision to which they may come. A verdict may be returned against medical evidence of the cause of death, of the most plain and convincing description, but this neither reduces its value nor impugns its correctness; and the course pursued by the medical witness, is as much a matter for future guidance as if the case had never been tried. At the same time it cannot be denied, that what is medically probable, may not always be legally proved to the satisfaction of a jury!

Fractures.—A simple fracture of the skull is not of itself dangerous, where the bones have not been separated: but it is rare that a fracture of the bones of the cranium is witnessed, without being complicated with concussion, extravasation of blood, or subsequent inflammation internally, to either of which consequences the danger must be assigned. It is necessary to observe, that a fracture does not always take place at the spot which receives the blow: it is often seen in a distant part of the skull. Thus a blow on the vertex, when sufficiently severe to produce fracture, often causes the bones to separate at the base of the skull, rather than in the immediate neighbourhood of the spot where the violence was inflicted. These counter-fractures, as they have been called, are chiefly seen in cases in which the violence has been applied to the cranium, by a body presenting a large surface. They are almost always situated at a point diametrically opposite to the part struck. Thus a violent blow on the vertex causes fracture of the base, indicated by a discharge of blood from one or both ears, owing to a rupture of the lateral sinus. A blow on the occiput will sometimes cause a fracture of the middle and lower part of the frontal bone,—while a blow on the lateral and upper part of the head, may be followed by a fracture of the orbitar plate. This is owing to the physical law that the parts in which the force applied to any hollow dome becomes concentrated, are diametrically opposite to each other.

Fractures of the skull, when accompanied by depression of bone, are usually attended with loss of consciousness and the power of moving; but when a portion of brain is lost, the depressed bone occupying the space of the cerebral substance which has escaped, does not always cause these symptoms. (See cases, antè p. 368.) Such injuries are highly dangerous; but nevertheless there are extraordinary instances of recovery on record, even where there has been a considerable depression of bone, combined with a great loss of substance of the organ. Those fractures, which involve the base of the skull, are more commonly accompanied by extravasation of blood, than those which are produced in the upper arch of the cranium; and such extravasations, from the large size of the vessels, which are there situated, commonly terminate fatally within a very short period; internal hæmorrhage, however, is not always the cause of death in these severe injuries. Sir Astley Cooper has recorded the case of a female, in whom a fracture took place from the vertex through the sphenoid bone, owing to a shutter having fallen on her head. This woman had no comatose symptoms, and she died after a short time in consequence of inflammation occasioned by the irritation of the fracture. On dissection, the fracture was found to extend through the basis cranii, so that it divided the skull into two nearly equal portions. In a case, which has been reported by Sir Charles Bell, fracture of the base of the skull, produced death in a very singular manner several weeks after the accident. On a post-mortem examination, it was found that the fracture had rendered the border of the foramen magnum rough, and that a small projecting portion of bone, by a sudden turn of the head, had become forced into the spinal marrow and destroyed life.

A medical jurist must not forget, that fractures may take place internally without any breach of continuity being seen on the external parietes. Thus a blow on the skull may cause a fracture of the internal table, without producing any appearance of fissure or fracture externally. In other cases the whole substance of the skull may be fractured without a division of the skin, where the force is of a bruising kind. (The Queen against Ward, Cent. Crim. Court, 1841.)

There is one remarkable circumstance connected with these fractures, accompanied by depression of bone, which here requires to be mentioned,—namely, that the person has been sensible so long as the foreign substance which produced the fracture and depression, remained wedged in the brain, and that insensibility and other fatal symptoms only began to manifest themselves after its removal. This being admitted, it may be urged in defence, that death was really caused by medical interference. But it is a sufficient answer to state, that the wounded person must have died from inflammation of the brain, if the foreign body had been allowed to remain; and that it is consistent with the soundest principles of practice, to remove all such foreign substances without delay. In fractures of the skull, with depression, it may become a question whether the surgeon raised the depressed portion of bone so soon as he ought to have done. See Case. Henke Zeitschrift der S. A. 1838. Erg. 230.

Wounds of the BRAIN itself sometimes prove instantaneously mortal even when slight, while in other cases, recoveries will take place from contused or punctured wounds of this organ, contrary to all expectation. When an individual survives the first effects of the injury, there are two sources of danger which await him: 1,—the production of fungus from the exposed portion of brain; and 2,—inflammation and its consequences. The process of inflammation, it must be remembered, is very slowly established in this organ: it may not manifest itself until from three to ten weeks after the injury.

THE FACE.—Wounds of the face are important on several accounts. When of any extent, they are usually followed by great deformity; and when penetrating the cavities in which the organs of the senses are situated, they often prove fatal by involving the brain and its membranes, or by giving rise to inflammation in that organ. Wounds of the eye-brows are not always of so simple a nature, as might at first sight be supposed. Besides being attended by deformity when they heal, they are liable to give rise, during the process of healing, to serious disorders of the neighbouring parts. Amaurosis and neuralgia are recorded among the secondary and not unusual consequences of such wounds, when the supraorbitar nerve has become at all implicated. Under certain conditions of the system, there may be inflammation of the parts within the orbit, extending by contiguity to the membranes of the brain, and proving fatal by leading to the formation of matter within that organ. In a work recently published, an instance is recorded of the occurrence of amaurosis in the right eye, after a contused wound, not of a very violent nature, to the right eye-brow. Dr. Wallace of New York has reported two cases of amaurosis following blows over the infra-orbitary nerve (Med. Gaz. xxxi. 931.)

Wounds apparently confined to the external parts of the face, frequently conceal deep-seated mischief. A sharp instrument penetrating the eyelid, and passing upwards with any force, will produce fracture of the orbitar plate of the frontal bone, which is known to be extremely thin, and even injure the brain beyond.

Sir Astley Cooper relates, that a girl, while playing with a pair of scissors, accidentally fell, and the point of the scissors passed upwards under the upper eyelid. It was found difficult to extract them; the eye became inflamed, but for some days after the accident, the child was in the habit of walking a considerable distance daily to receive medical advice. In about ten days, she suffered violent pain, with symptoms of inflammation of the brain, under which she died. On inspecting the body, it was found that the orbitar process of the frontal bone had been fractured, the dura mater torn, and the anterior lobe of the brain lacerated. In several instances in this country, trials for murder have taken place, in which death has been caused by a penetrating wound of the orbit fracturing the orbitar plate and injuring the brain. In the year 1735, the celebrated Macklin, the comedian, was tried for having caused the death of Thomas Hallam, by thrusting a stick into his eye. On inspecting the body of the deceased, it was ascertained that the stick had entered the brain; the prisoner was found guilty of manslaughter. It is necessary for the witness to bear in mind, that such an injury may be produced by the application, comparatively speaking, of only a moderate degree of force. A somewhat similar case occurred at Liverpool, in February, 1843, where a boy killed another by wounding him with a gimlet in the eye. The brain was perforated, and he died in two days. The following instance, reported by Mr. Watson, will show what a very simple cause may produce a serious wound of this description.

A boy, aged ten, had the birch end of a common broom thrust several times into his face by one of his companions. He became stunned, and was carried home in a state of stupor. He afterwards complained of violent pain in the eyeball and forehead. Symptoms of inflammation and fever supervened, followed by coma, convulsions, and insensibility. He died in about sixteen days after the accident. On dissection, the orbitar plate was found perforated, and pus and lymph were effused at the base of the brain. The left ventricle contained three ounces of pus, and communicated with the wound in the orbit. A small portion of bone was partially separated from the orbitar plate, and projected upwards. For many similar cases, and one in which death took place in six hours, from a wound made by a tobacco-pipe, see Hoffbauer Ueber die Kopfverletzungen, p. 49, 1842. In infants and young children the partition between the orbit and the brain is almost membranous, and is therefore perforated by the slightest causes.

A man was tried in Scotland, in 1827, for killing a girl, by shooting her. The prisoner had inadvertently discharged a gun towards the high road where the deceased was standing. She received the shot in her face, but the wounds appeared quite superficial. She died in three days, and it was found that one small pellet had penetrated the orbitar plate and perforated the brain.

It would appear, from a case reported by Dr. Scott, that the orbitar plate need not always be perforated, in order that fatal inflammation of the brain should be set up. A deeply penetrating wound of the orbit has caused death under the usual symptoms of cerebral disturbance. (Ed. M. and S. J. xliii. 263.)

THE NOSE.—These wounds are, generally speaking, of a simple nature, rarely giving rise to serious symptoms, but they are almost always attended with great deformity. If the injury be contused and, at the same time, extensive, a loss of the faculty of smelling will probably result. A penetrating wound of the nose, produced by passing a sharp-pointed instrument up the nostril, may destroy life by perforating the cribriform plate of the ethmoid bone and injuring the brain. Such a wound, it is obvious, might be produced without leaving any external marks of injury.

Dr. Corkindale, of Glasgow, met with a case in which a man died from the effects of a wound of the nose, whereby the nasal bones were fractured, nine weeks after the injury. On inspection there was copious inflammatory effusion at the surface of the brain, particularly at the part corresponding to the seat of the violence.

Wounds of the face, when at all extensive, are always followed in healing, by greater or less deformity. The medical witness may perhaps find these questions put to him in relation to them. Is the wound likely to be attended with deformity? Could such a wound of the face heal without deformity? or could the deformity, if it exist, have been produced by any other cause than the wound? These questions are of more importance than may at first sight appear. Thus a person may allege that he was severely wounded in the face, when the medical witness on examination, may find no trace of such a wound as that described. Or a person may seek damages from another in a civil action, by alleging that a particular deformity was produced by a wound, when the medical witness may be able to trace its origin to disease.

A case in which these questions were raised, was lately referred to me under the following circumstances. Some of the particulars of this case, have been elsewhere stated. (Antè, p. 304.) (The Queen against Henry Reed and Elizabeth Donelan, Chelmsford Spring Assizes, 1842.) The medical evidence was to the effect, that " there was a wound on the nose of the prosecutrix, apparently inflicted by some sharp instrument, and the bridge of the nose was broken down. The weapon had entered half an inch. and had caused profuse bleeding. The wound was sufficiently deep, that if it had entered a little higher up in the eye, it might have caused death." In the defence, it was urged that no weapon had been used; and that although the male prisoner had struck the prosecutrix a blow, the female prisoner had taken no share in the assault. It does not appear that any medical evidence was called to show in what state the face of the prosecutrix was at the time of the trial. It was assumed that a weapon must have been used, and the prisoners were convicted, the one of stabbing and the other of aiding and abetting.

About six months after the alleged stabbing, and some weeks after the prisoners had been convicted and sentenced to punishment, the face of the prosecutrix was examined by two surgeons, one of them a practitioner of twenty-eight years standing, and they both deposed that there was no mark of a cicatrix or a fracture of the nose or of any personal injury whatever. Other surgeons were requested to examine the face of the prosecutrix, but this she declined permitting; and as there was no power to compel her, the case was referred to Professor Quain, Mr. Guthrie, Mr. Key, and myself. The evidence of the surgeon at the trial was laid before us with the statements of the two surgeons, who examined the prosecutrix afterwards. We all agreed that if such a wound as that described in the medical evidence had been inflicted, there would have been a visible scar and a ridge or prominence indicative of the situation where the bridge of the nose was stated to have been broken down : and as no such marks could be perceived by two well informed surgeons, we considered it improbable either that such a wound as that described could have been inflicted, or that a weapon could have been used in the assault. Memorials to this effect were addressed to the judge ; but we could not even cause the matter to be reconsidered. It is clear that a great medical error must have been committed somewhere ; but unfortunately in England there can be no rehearing of a criminal case,—this privilege of correcting mistakes by a jury is confined only to civil actions. In the mean time the medical jurist will learn from this case, that the question, whether serious stabs in the face with fracture of the nasal bones are liable to heal with or without leaving any trace of their past existence, is of some moment. Could all traces of such a wound as that above described be effaced in a period of six months, or even during the life of a person ?

INJURIES TO THE SPINE.—Injuries to the spine and spinal marrow seldom require medico-legal investigation : but this organ is liable to concussion from blows, to compression from fracture of the vertebræ, or the effusion of blood, with all the secondary consequences attending such accidents. Concussion of the spinal marrow commonly produces paralysis :—but the symptoms may be of a still more alarming kind; and after death no traces of mechanical injury may be discovered. Blows on the spine unattended with fracture or dislocation, may, according to the observations of Sir B. Brodie, be followed by inflammation and softening of the spinal marrow. A very slight injury has been known to cause death by giving rise to inflammation of the spinal marrow. (See Henke Zeitschrift, der S. A. 1840, 2, 407.) This organ is also liable to compression from very slight causes, as will be evident from the following medico-legal case reported by Mr. King, of Glasgow.

A man was tried on a charge of manslaughter. It appeared in evidence that he had thrown deceased on the ground, and while he was attempting to rise he caught him by the throat, forcing him backwards, and bringing his head violently in contact with the ground. Deceased died after a few convulsive gasps. On inspection, the spinal cord was found to be compressed between the body of the fourth and the arch of the third vertebra, but on removing it, no indentation or laceration of its substance was perceptible. Death had ensued from paralysis of the phrenic nerves. It is remarkable that so slight a degree of violence should have caused so serious an injury, for the affair took place before eye-witnesses. This case shows the necessity of inspecting the vertebral column, when death is alleged to have been caused by violence and no traces of it are perceptible in other parts of the body. Indeed it is not improbable that in most cases of sudden death from alleged or suspected violence, where the cause is obscure, if the spinal marrow were examined, the fatal result might be explained by the discovery of some mechanical injury or morbid changes in this organ. This part of a medico-legal inspection is, however, commonly neglected.

Fractures of the vertebræ are generally attended by displacement and compression of the spinal marrow. They are the more rapidly fatal in proportion as the injury is high up in the vertebral column, the whole of the body being paralysed below. If the seat of compression be above the fourth cervical vertebra, death is commonly immediate. In these accidents it sometimes happens that the dentiform process of the second vertebra is broken off. From a case related by Mr. Phillips, it would appear that this accident is not always attended by fatal compression. (Ed. Med. and Surg. Journ. Jan. 1838.) On several criminal trials this injury has been proved to have been the cause of death : and in a memorable case, tried at Glasgow, some years since, (the King against Reid,) it became a material question, how far an injury of this kind might result from disease. It may happen that caries of the bone or disease of the transverse ligament will cause a separation of the dentiform process from the second cervical vertebra. The state of the bone should, therefore, be closely examined. In Reid's case an acquittal took place, partly because the deceased had laboured under disease of the spine, and the exact state of the parts had not been noticed. Disease of the ligaments may also lead to a separation, and slow or rapid death, according to the degree of pressure.

A case occurred not long since where a lunatic in a private asylum, suddenly threw her head back in order to avoid taking some food that was offered to her; and she died evidently from the compression produced by the displacement of the dentiform process.

A woman died suddenly a month after her confinement. She had been suckling her child at one o'clock in the morning, and at four she was found dead. The viscera of the abdomen, thorax, and head were carefully examined without finding anything to account for her death—when, as the brain was being returned into the skull, Mr. J. Wilson noticed a projection at the foramen magnum. On examination, this was found to be the dentiform process of the second vertebra luxated backwards: this had so injured the spinal marrow as to destroy life. (Med. Gaz. iii. 582.) It is not stated whether the parts were in a healthy or diseased condition.

The following case shows that the rapidity of death will depend on the degree of compression. A girl had a stiff neck, as it was supposed, from cold. Her head was continually twisted to the left side, but she possessed the power of moving it in the opposite direction. While in this state a man suddenly seized her and gave her head a violent twist. She felt immediately a severe pain, lost the power of turning her head to the right, and had difficulty of swallowing. These symptoms continued to increase for a month, and she ultimately died under a paralytic affection. On inspection the odontoid ligaments were found ruptured, but there was no mark of suppuration. The bones were healthy. The dentiform process had compressed the anterior columns of the spinal marrow, which were softened; and it was observed during life that she had lost more the power of motion than of sensation. (Gaz. Medicale, Nov. 1842.)

Compression of the spinal marrow sometimes arises, though rarely, from effusion of blood produced by blows or falls—but it is important to remember, that these effusions may also take place from spontaneous causes. On an examination being made of the body of a person who had died from an accidental fall, a coagulum of blood was found effused into the substance of the spinal marrow exactly opposite a fracture of the body of the sixth cervical vertebra.

Injuries to the spine and its contents, are generally the result of falls or blows either on the head or the lower part of the column. The secondary consequences are sometimes very insidious, so as to disarm suspicion, and death may take place quite unexpectedly some weeks after the accident. Spiculæ of bone separated by fractures, may remain adherent for some time; and by a sudden turn of the head be forced off and destroy life by penetrating the spinal marrow at a long period after the receipt of the injury. (See antè, case by Sir C. Bell.) This has been known to happen in fractures, involving the margin of the foramen magnum, and in such cases, death is immediate. The spinal marrow has been in some instances wounded in its upper part by sharp-pointed instruments introduced between the vertebræ. Death is an instantaneous result, when the wound is above the third cervical vertebra:—there is no part of the spine where a weapon can so readily penetrate as this, especially if the neck be bent forward. The external wound thus made may be very small and if produced with any obliquity by drawing aside the integuments, it might be easily overlooked, or it might be set down as superficial.

THE CHEST.—These wounds have been divided into those which are confined to the parietes, and those which penetrate the cavity. The division is important, so far as it relates to the prognosis of such injuries.

Incised or punctured wounds of the parietes of the chest are rarely followed by dangerous consequences. The hæmorrhage is not very considerable, and is generally arrested without much difficulty. They heal either by adhesion or suppuration, and unless their effects be aggravated by incidental circumstances, the prognosis is very favourable.

Contusions or contused wounds of the thoracic parietes are, however, far more dangerous; and the danger is always in a ratio to the degree of violence used. Such injuries, when severe, are ordinarily accompanied by fractures of the ribs or sternum,—by a rupture of the viscera within the cavity, including the diaphragm,—by profuse hæmorrhage,—or, as an after-effect, by inflammation of the organs, with or without suppuration. Fractures of the ribs are dangerous for several reasons:—the bones may be splintered and driven inwards, thereby wounding the lungs and causing hæmorrhage, or leading to inflammation of the pleura or lungs. In fractures of the upper ribs, the prognosis is less favourable than in those of the lower, because, commonly, a much greater degree of violence is required to produce the fracture. A simple fracture of the sternum, without displacement of the bone, is rarely attended with danger, unless the concussion has at the same time produced mischief internally, which will be known by the symptoms. When, however, the bone is depressed as well as fractured, the viscera behind may be mortally injured. In a case of depressed fracture of the sternum, recorded by M. Sanson, the individual died after the lapse of thirteen days; and on inspection, it was found that the fractured portion of bone had produced a transverse wound of the heart about an inch in length. The cavities of the organ had not been penetrated, but the piece of bone was exactly adapted to the depression produced by it on the parietes. (Devergie, Mèd. Lèg. vol. ii. p. 243.) A witness will frequently be required to take into consideration the effects of contusions on the thorax, with or without fracture, in cases of death from pugilistic combats which of late years have given rise to so many trials of manslaughter.

Wounds penetrating into the cavity of the thorax, are generally dangerous even when slight, in consequence of the numerous accidents with which they are liable to be complicated. In these wounds, the lungs are most commonly injured; but, according to the direction of the weapon, the heart, or the great vessels connected with it, as well as the œsophagus or thoracic duct, may share in the mischief.

THE LUNGS.—The immediate cause of danger from wounds of these organs is the consequent hæmorrhage, which is profuse in proportion to the depth of the wound and the size of the vessels wounded. Should the weapon divide any of the trunks of the pulmonary veins, the individual may speedily sink. The degree of hæmorrhage cannot be judged of by the quantity of blood which escapes from the wound; for it may go on internally, and collect within the cavity of the pleura, impeding the respiratory process. This is especially to be apprehended where the external orifice is small and oblique, and one of the intercostal arteries has been touched by the weapon. A wound of the lung is generally known, among other symptoms, by the frothiness and florid colour of the blood which issues from the orifice, as well as by the expectoration of blood.

The lungs may sustain serious injury from a blow or fall, and yet there may be no external marks of violence or symptoms indicative of danger for some hours.

A young man, while riding, fell from his horse on his left arm. He complained of no pain for five hours, but in twelve hours he was seized with an alarming flow of blood from the mouth. He died in the course of a few days. After death there was no mark of injury to the chest, but the right lung was ruptured posteriorly throughout its length, and much blood had become extravasated. (Lancet, Nov. 1842.)

During the convalescence of an individual who has survived the first effects of a penetrating wound of the chest, the surgeon should observe whether death, when it occurs. may not have been caused by any imprudence on the part of a patient, as by abuse of regimen or other misconduct; for, it has been already remarked, circumstances of this nature, would be regarded as mitigatory on the trial of an aggressor. Thus it is very properly recommended that, in all cases where a party is progressing to recovery, a relaxation of the antiphlogistic regimen should be made with great circumspection. Too much nourishment, too frequent talking or any exertion, are circumstances that may cause a renewal of the hæmorrhage and extravasation. A case is related in which a soldier died instantly from internal hæmorrhage, brought on by throwing a bowl at some nine-pins, two months after he had been apparently cured of a wound of the lungs.

THE HEART.—These are among the most fatal of penetrating wounds of the thorax. It was formerly considered that all wounds of this organ were necessarily and instantly mortal. Undoubtedly, when either of the cavities is laid open to a large extent, the hæmorrhage is so profuse on the withdrawal of the weapon, that death must be almost immediate. But where the wound is small and penetrates into the cavities of the organ obliquely, then it is seen that life may be prolonged for a considerable period; and cases are on record in which it is probable that such wounds would have healed, and the patients have finally recovered, but for the supervention of other diseases which destroyed life.

Dupuytren has reported the case of a man who received a stab on the left side of the chest, on November 5th, 1831. He was brought to the Hôtel Dieu, but the symptoms under which he laboured, did not lead to the suspicion that he had received a wound of the heart. The man died on the 13th, of cerebral disease. On inspection of his body, it was found that the left ventricle was wounded about the middle and a little to the right; its cavity having been penetrated in a transverse direction. The wound was three lines and a half across, and one line from above downwards. The external fibres of the organ were most separated, the opening diminishing gradually, so that the internal fibres were in contact and closed the wound.

A boy, in pulling a knife from a companion with the point towards him, accidentally stabbed himself in the chest. A small quantity of florid red blood escaped—he vomited and fell to the ground. He died in eight days. The left ventricle had been perforated, and one pound and a half of blood was effused in the thorax. This case shows that the fatal hæmorrhage is not always immediate. (Med. Gaz. ii. 721.)

In another instance recorded by Baron Dupuytren, five or six wounds were made by means of a saddler's needle,—most of them penetrating into the right ventricle of the organ. This man died of cerebral disease, twenty-five days after the wounds could have possibly been inflicted; for the needle was taken from him twenty-five days before his death, without any suspicion being entertained of his having wounded himself with it. The external cicatrix was visible on an inspection of the body. The quantity of blood found in the chest amounted to about three ounces, and this appeared to have proceeded from the substance of the heart. (Med. Gaz., vol. xiii. p. 662, et seq.)

Other cases are mentioned in illustration of the position that wounds of the heart are not instantaneously mortal; but, in the opinion of the Baron, they also show that these injuries are not necessarily fatal, although I believe there is no case on record in which a person has recovered from a penetrating wound of the cavities. There are few, probably, who will be inclined to consider them curable; a remote possibility of simple wounds healing, and of the patient recovering, may be admitted; but until some clear instances of recovery from penetrating wounds of the cavities are reported, the majority of practitioners will continue to look upon them as necessarily, although not immediately, fatal. From a series of cases, collected by MM. Ollivier and Sanson, it appears, that out of twenty-nine instances of penetrating wounds of the cavities of the heart, only two proved fatal within forty-eight hours. In the others, death took place at the varying periods of from four to twenty-eight days after the receipt of the wound. (Devergie, Med. Lég. vol. ii. p. 246.) These differences in the time at which death occurs, as well as the reason why wounds of the heart do not instantly destroy life, have been ascribed to the peculiar disposition of the muscular fibres of the organ, and to the manner in which they are penetrated by a weapon. Thus, as a general principle, it is stated that wounds which are parallel to the axis of the heart, are, cæteris paribus, less rapidly fatal, than those which are transverse to its axis. In a wound which divides the fibres transversely, the opening will be larger, and the hæmorrhage greater, than in one which is parallel to these fibres; and as the heart is composed of different layers, of which the fibres pass in different directions, so in a penetrating wound of its cavities, while one set tends to separate the edges, another tends to bring them together and to restrain the flow of blood. It is this action of the fibres, which renders wounds of the ventricles less rapidly fatal than those of the auricles, all other circumstances being equal;

but a man has been known to survive a laceration of the left auricle for eleven hours. (See Lancet, Jan. 1841.) The presence of a weapon in the wound, also retards the fatal result, mechanically obstructing the effusion of blood. The following case may be cited in proof of this statement.

A lunatic, about thirty-four years of age, wounded himself with a long sharp instrument on the left side of his chest. Two days afterwards, he was admitted into the Bicêtre, labouring under oppressed breathing, intermittent pulse and other serious symptoms. The wounded man stated. that he had plunged the instrument into his chest, and had not been able to withdraw it. His symptoms became more aggravated, and he died the twentieth day after the wound. On inspection, the pericardium and the surrounding parts were found inflamed; and on opening the heart, an iron stiletto was discovered to be firmly imbedded in the substance of the left ventricle, which it had entirely traversed, so that its point projected a few lines into the cavity of the right ventricle. The man had obviously died from extravasation of blood; but this had taken place slowly, and, only after the period of time mentioned, had the hæmorrhage sufficed to destroy life. (A similar case, antè, p. 393.)

It appears from a series of observations by M. Ollivier and others, that the right cavities of the heart are more frequently wounded than the left, and of these the right ventricle is most commonly the seat of injury. Out of sixty-four cases of wounds of this organ, twenty-nine were situated in the right ventricle, twelve in the left ventricle, nine in the two ventricles, three in the right auricle, and one in the left auricle. These differences are readily accounted for by the relative situation of the cavities. It appears also, from M. Ollivier's observations, that wounds of the right ventricle are not only the most frequent, but of all others, they are the most rapidly mortal. It is considered that the suddenness of death in severe wounds of the cavities of this organ, is to be ascribed not merely to the loss of blood, but to the degree of compression which it experiences from the blood poured out into the bag of the pericardium.

The heart is liable to be ruptured either from disease or accident. The organ generally gives way towards the basis, and through one of the cavities on the right side. (For cases see Med. Chir. Rev. xxxi. 532.) The symptoms are sudden pain and collapse, and death speedily ensues:—according to the circumstances under which they occur, these cases of rupture from disease may always excite a suspicion of death from violence. Sometimes the substance of the heart appears to undergo a fatty degeneration; but at others there is no apparent cause for the accident. Dr. Stroud reported to the Med. Chir. Society, a case of this kind, which occurred in a young man aged twenty-nine. The deceased died in ten hours after his first seizure: on inspection there was a small aperture in the right auricle near the vena cava. This did not appear to be connected with any morbid condition of the heart. (Med. Gaz. xxvi. 518.)

As a medico-legal subject, it is worthy of note that when this alarming accident proceeds from blows or falls, it is not always accompanied by any marks of external violence,—or any fracture or other injury to the parietes of the thorax. A case is recorded by Dr. Gairdner, in which a cart-wheel passed over the chest of a child, and occasioned instant death. Dr. Christison met with two similar instances, one caused by a fall, and the other by a blow. I have been enabled to collect two others, one of which was communicated to me by Dr. Geoghegan of Dublin.

A child was killed, as it was supposed, by the wheel of a carriage going over its chest. On inspection the integuments, muscles, and ribs, were entirely free from any marks of injury. The pericardium was lacerated, and a pint of blood was effused into the right pleural cavity. The heart was found ruptured throughout its entire length. In another case, which occurred to Mr. Jeffery, of Sidmouth, a man fell from a cliff the height of one hundred feet. There were a few slight bruises about the body, but no serious wound or fracture. On opening the chest, the pericardium was found to be distended with dark fluid blood, which had escaped from an irregular opening about three quarters of an inch in diameter, situated in the anterior portion of the right auricle. (For another case, see Cyc. Pr. Med. iv. 557.)

Wounds of the *large arterial and venous trunks*, around the heart, must be considered as decidedly mortal: death is generally instantaneous from the profuse hæmorrhage which attends them. Dr. Heil, of Bamberg, has related a case which he considers to prove that a person may recover from a penetrating wound of the ascending aorta. (Henke Zeitschrift, 1837, ii. 459.) With regard to these fatal extravasations of blood within the chest, as well as in the other great cavities, it may be proper to mention that, from whatever vessel or vessels the blood may have issued, it is not commonly found coagulated to any extent. The greater part of it generally preserves the liquid state: and it is rare that so much as one half of the quantity effused, is met with in the form of coagulum. These extravasations of blood in the chest may be sometimes traced to wounds of the intercostal, the internal mammary arteries, or of the vena azygos.

THE DIAPHRAGM.—This muscular septum is liable to be wounded by weapons which penetrate the cavity of the thorax or abdomen; but, under any circumstances, such wounds are not likely to occur without implicating the important organs that are in contact with it. It is scarcely possible, therefore, to estimate the danger of these injuries, as the prognosis must materially depend on the concomitant mischief to the viscera. Slight penetrating wounds of the muscle may heal, like those of other muscular parts; and cases of this kind are on record. There is, however, always a consecutive source of mischief which no remedial means can avert;—namely, that after the wound has, to all appearance, healed, the life of a party may be cut short by the strangulation of a portion of the stomach or viscera in the half cicatrized aperture. An instance reported by Dr. Smith affords an illustration of this. A sharp-pointed weapon had penetrated the diaphragm, notwithstanding which the patient made a rapid and perfect recovery, to all appearance. An the end of about three months the man died from a strangulated hernia of the stomach, which had passed through the wound of the diaphragm into the thorax. (For. Med. p. 279.)

In a case of this description, where death occurs at a very considerable period after the infliction of a wound, the witness will probably be asked :—Whether the wound was the cause of death? Or whether there were any circumstances which would have caused or facilitated the production of a hernia? The degree of culpability of an aggressor would materially depend upon the answers returned to these questions. Phrenic hernia, as it is termed, is not by any means an unusual or unexpected fatal consequence of a wound of the diaphragm; and therefore it would appear, at first sight, that death, at whatever period this event might occur, should be referred to the original wound. But the question is of a very delicate nature; as it is possible that a slight blow on the stomach, received subsequently to the wound, or even any moderate exertion on the part of the deceased, might have tended to the production of the strangulation, or at least might have added to its fatal effects.

The most serious wounds of the diaphragm, are unquestionably those which are produced by violent contusions, or falls on the parietes of the abdomen, while the stomach and viscera are distended. In these cases the muscular fibres are commonly found ruptured to a greater or less extent: the hæmorrhage is not very considerable, rarely exceeding two, three, or four ounces. A uniform effect of these ruptures when extensive, is a protrusion of the stomach into the chest, with sometimes a rupture of the coats of that organ and extravasation of its contents. The severe lacerations of the diaphragm are more readily produced during the act of inspiration, than during expiration,—the fibres of the muscle being then stretched and receiving, while in this state of tension, the whole of the force. According to Devergie, the rupture most frequently takes place in the central tendinous structure, where it is united with the left muscular portion above the crura. He has remarked that it is observed more commonly on the left side than on the right. (Vol. ii. p. 250.) It has been supposed that death was an immediate consequence of this accident, but this view is not supported by facts. I have elsewhere related a case of extensive rupture of the diaphragm where the stomach and the colon were found in the chest, and yet the person lived nine months after the only accident which could have produced it, and then died from another cause. (G. H. Rep. Oct. 1838.) Besides the stomach, it sometimes happens that the liver, spleen, or intestines pass through the opening, and like it, these organs are liable to become strangulated: the lungs are, at the same time, so compressed that inspiration is stopped and asphyxia is often an immediate result.

In judging of the direction which wounds traversing the antero-posterior axis of the chest, take, it is necessary to remember the great difference which exists in the level of the same rib anteriorly and posteriorly. This must be especially attended to, when we are called upon to state the direction of a traversing wound from the description of it, given by another. The point here referred to had an important bearing in the case of a fatal gun-shot wound which was the subject of a criminal charge some years since. (Henke's Zeitschrift, 1836.)

A person died from a single pellet of small shot traversing the chest from before backwards. The pellet entered between the first and second ribs anteriorly, and traversing the lung, caused death by lacerating the sixth intercostal artery, near its origin at the lower edge of the sixth rib, posteriorly. In giving an opinion on the direction of the wound, a fact which was important in regard to the position of the assailant,—one medical witness, from not duly considering the sloping of the ribs from behind forwards, described the wound behind as being six inches below the level of that in front. As the small canal through the lungs could not be discovered, he was inclined to think that the two wounds could not be connected, because the gun had been discharged from the shoulder when the party firing was nearly on a level with the deceased. This opinion, however, was soon corrected by reference to the anatomical relations of the parietes of the thorax. Indeed it will be found, that a straight line carried backwards from between the first and second ribs in front, will, in a well-formed skeleton, touch the upper border of the fifth rib posteriorly: therefore this wound was nearly horizontal,—being only one inch and a quarter lower posteriorly, than anteriorly. In a late fatal duel, the bullet struck the deceased on the right side, fracturing the seventh rib, and after traversing the posterior part of the lungs, lodged in the ninth dorsal vertebra. These parts are in a line with each other, and the wound was horizontal. It must not be forgotten that a wound immediately below the chest-bone, will in its fore part involve the viscera of the abdomen,—in the back part those of the chest, and in its central part it will traverse the diaphragm.

THE ABDOMEN.—Incised and punctured wounds which affect the parietes of the abdomen, without penetrating the cavity, are not quite of so simple a nature as might at first sight be imagined. The danger is immediate, if the epigastric artery be wounded; for a fatal hæmorrhage will, in some instances, take place from a wound of this vessel.

In a case which occurred to Dr. Colles, of Dublin, a carpenter who had a chisel in his pocket, stumbled in walking and received a wound in the abdomen with the edge of the instrument. When brought to the hospital, the man appeared exhausted from the loss of blood,—the skin was cold and pallid; he gradually became weaker, the pulse imperceptible, and he died a few hours after his admission. On an examination of the body, the epigastric artery was found divided, and the cavity of the peritoneum distended with blood. It is true, that in this case, the abdomen was penetrated; but the real cause of death, was the blood lost from the wounded artery. Mr. Travers mentions, that a man was brought to St. Thomas's hospital, who had been stabbed in the direction of the epigastric artery on the left side of the abdomen, with a case-knife. He died in eighteen hours, apparently owing to copious hæmorrhage from that vessel.

Among the other sources of danger from these superficial wounds, is inflammation, followed by suppuration beneath the tendinous aponeurosis which covers the abdominal muscles. The matter formed is very liable to accumulate within the tendinous sheath of the rectus muscle, and go on to destroy life, unless proper treatment be adopted. The inflammation will sometimes extend to the peritoneum, and thus prove rapidly mortal. As improper medical treatment may, in either of these ways, cause a superficial wound of the abdomen to take a fatal termination,—so when an individual stands charged with having inflicted a wound, it willbe necessary for the medical witnesses to consider how far the consequences of the act of the prisoner have been aggravated by negligence or unskilfulness.

But when these wounds take a favourable course and heal, there is an after-effect to be dreaded, namely, a protrusion of the viscera at the cicatrized spot, constituting ventral hernia. When the wound has involved the muscular fibres transversely to their course, the cicatrix which follows, is commonly far less capable of resisting the pressure of the viscera within, than other parts of the parietes. A hernia will take place, and this, like other herniæ, if neglected, is liable to become strangulated and lead to the destruction of life.

Contusions are attended generally with far more serious effects on the cavity of the abdomen, than on the thorax. This arises from the abdominal parietes having less power to resist external shocks. In the first place, death may be an immediate result of a blow in the upper and central portion; no particular morbid changes will be apparent on inspection, and the violence may have been so slight, as not to have left any ecchymosed mark on the skin. Death has been ascribed in these cases to a fatal shock transmitted to the system, through a violent impression produced on the solar plexus.

In a case of manslaughter tried at the Cent. Crim. Court, in Aug. 1841, death had been caused in this way during a pugilistic combat. The man received a blow in the stomach and fell dead. As there were no marks of external injury, the surgeon thought the man had died of apoplexy. The prisoner was acquitted. (The Queen against Sayers.)

Blows on the abdomen, when they do not destroy life by shock, may cause death by inducing peritoneal inflammation. Several cases of this kind are mentioned by Mr. Watson, (On Homicide, 186,) and more than one has been tried of late years where violence to the abdomen was proved, but no mechanical lesion had been produced : the wounded person, however, died from peritonitis in the course of a few days. (The Queen against Martin, Cent. Crim. Court, 1839.) Peritonitis thus induced, is apt to be accompanied by inflammation of several membranes in other cavities :—thus, it is said, a person may be cut off by pleuritis depending on an attack of peritonitis, produced by violence, while the former disease would probably be referred to some other cause. In a case which occurred a few years since,—a woman received some severe blows on the abdomen from her husband. She died in five days afterwards. There were marks of pleuritis and peritonitis on dissection, the former much more decided. The medical witness, while he allowed that the peritonitis might have been caused by blows, thought that death had been produced by an attack of pleuritis from cold. The jury acquitted the husband.—The reporter of the case considers that the attack of pleurisy was immediately dependent on the peritoneal inflammation produced by the violence. (See

Med. Gaz. xxv. 13.) This doctrine requires confirmation before it can be safely applied to medico-legal practice. Such a sympathetic connexion between the two diseases must not only be rendered probable, but actually proved.

Blows upon the abdomen may also prove fatal by causing a rupture of the viscera with extravasation of blood;—and as it has been elsewhere stated, these serious injuries may occur without being attended by any marks of external violence. Of all the internal organs, the liver and spleen are the most exposed to rupture, owing to their very compact structure, which prevents them from yielding to a shock, like the hollow viscera. Ruptures of the *liver* occur from falls or blows; but this organ may be ruptured merely by a sudden action of the abdominal muscles. This accident happened to an individual who was endeavouring to avoid a fall from his horse. (Male's Jur. Med. 119.) They are generally seen on the convex surface, seldom extending through the whole substance of the organ, but consisting of fissures, varying from one to two inches in depth. Their usual direction is from before backwards, with a slight obliquity; they rarely intersect the liver transversely. The lacerated edges are not much separated, while the surfaces present a granular appearance. But little blood is met with in the laceration; it is commonly found extravasated in the lower part of the cavity of the peritoneum, or in the hollow of the pelvis, and is only in part coagulated. Ruptures of the liver, unless they run far backwards and involve the vena cava, are not in general attended with a considerable extravasation of blood; but the hæmorrhage, should this vessel be implicated, is sufficient to cause the instant destruction of life. Under other circumstances, a person may survive some hours.

In June 1841, a drunken man was brought to Guy's Hospital. There was no mark of violence about him,—but he appeared helpless from intoxication. He died in about nine hours, and two quarts of blood were found effused in the abdomen. This had come from a large rupture in the right lobe of the liver. It had probably been poured out slowly, for the man was able to move about just before he died.

Ruptures of the *spleen* may occur either from violence or disease, and it would appear from the following case, reported by Mr. Heddle, (Med. Chir. Rev. Oct. 1839,) that a very slight degree of violence is sufficient to rupture this organ, while there will be no marks of injury externally.

A middle-aged man was observed fighting with a boy about fourteen years of age, who in stature scarcely reached to his waist. When the fight terminated, the boy ran away; the deceased was observed to become very weak and faint, and he complained of uneasiness in his left side. He expired a few minutes afterwards. On inspection, there was no mark of violence externally. The cavity of the abdomen contained a large quantity of blood. The spleen was found enlarged, and so softened, that its structure was broken down by the slightest pressure. There was a laceration across its surface, about half an inch in depth, from which the fatal hæmorrhage had proceeded. A case of spontaneous rupture of the spleen, when in an enlarged and diseased condition, will be found in the Medical Gazette, (June 1842.) It is highly probable, that when the liver and spleen are ruptured from slight causes, these organs will be found diseased,—a circumstance which may be regarded as mitigatory of the act of the assailant.

Wounds or ruptures of the *gall-bladder* are fatal, owing to the extravasation of the bile, which uniformly induces peritonitis.

Ruptures of the *intestines* sometimes take place from disease, and in a case of rupture alleged to have been produced by violence, we must always take this possible objection into account. The ruptured part should be carefully examined, in order to see whether there be any signs of ulceration about it. If not, and there is clear evidence of violence having been used, it is impossible to admit this speculative objection. If with the proof of violence there should also be a diseased condition of the bowel, we may be required to say whether in consequence, there was not a greater liability to rupture,—a point which must be admitted. For interesting medico-legal cases see Watson on Homicide, 159; also, Henke Zeitschrift der S. A. 1836, Erg. xxii. and Brit. and For. Rev. iv. 519. Ruptures of the intestines will occur from the slightest causes. Any force suddenly applied, as a smart shock to the abdomen, will sometimes suffice to cause it. A case has already been related where the blow of a pebble ruptured the jejunum of a young girl by striking the abdomen. It is worthy of remark, that a rupture of the intestines does not necessarily deprive the person of the power of locomotion. Mr. Collier has reported the case of a boy aged thirteen, whose duodenum was completely ruptured across by a blow, who walked a mile with but little assistance; he died in thirteen hours. (See Med. Gaz. xii. 766.)

Punctured wounds which merely touch the bowels without laying open the cavity, are liable to cause death by peritonitis. These injuries to the intestines sometimes destroy life by shock; there is but little blood effused, and the wounded person dies before peritonitis can be set up. That rupture of the intestines is not incompatible with the power of locomotion, is also proved by a case related by Mr. Ellis, of Dublin, where the cœcum was ruptured; the man was able to walk after the accident, but he died in twenty-four hours. Other instances of this kind are reported by Henke. The ileum is observed to be most liable to rupture from accident.

Ruptures of the *stomach* may cause death by shock; they give rise to the most excruciating pain, which of itself is sufficient to bring about rapid dissolution. It is proper to state, however, that the stomach may become ruptured from spontaneous causes, as in ulceration produced by disease, (antè, p. 58,) but sometimes there is no morbid cause to explain the result.

In April, 1828, a man aged thirty-four, was brought into St. Bartholomew's Hospital, complaining of severe pain in the abdomen. Ten hours afterwards, he was seized with violent vomiting, the pain ceased, the vomiting also ceased; and he died in five hours more. The posterior surface of the stomach was found lacerated to the extent of three inches, and the contents of the organ had escaped through the aperture; the mucous membrane was reddened, but there was no thickening ulceration or any apparent disease of the stomach. (Med. Gaz. ii. 182.)

It is obvious, that in alleged ruptures from violence, accidents of this kind must not be forgotten. Penetrating wounds of the stomach generally prove rapidly mortal; they seldom form a subject of medico-legal examination; but a singular case was tried at the Norwich Assizes in 1832, where a man was charged with the murder of his wife, by throwing at her a red-hot poker. The weapon completely perforated her stomach, and she died in six hours. It might be questioned whether this was a wound in the common sense of the term; it was an injury compounded of a burn, puncture, and laceration.

Rupture of the *bladder*. This injury is frequently the result of blows on the lower part of the abdomen, and it has on several occasions of late years given rise to some medico-legal discussion. The principal questions to be answered are: Was the rupture the result of wilful violence or of an accidental fall? or did it proceed from spontaneous causes, as from over-distension? The spot where rupture commonly takes place is in the upper and posterior part, where the organ is covered by the peritoneum. The aperture is sometimes large, at others small; but the effect is, that the urine is extravasated and death takes place through peritoneal inflammation. These ruptures have, I believe, without exception, proved fatal from this cause. The time at which death occurs is in from three to seven days, but Mr. Ellis met with a case where the person did not die until the fifteenth day. There is another circumstance of medico-legal importance in respect to these ruptures, namely, that when produced by a blow, they are rarely accompanied by the slightest mark of ecchymosis, or of injury to the skin. Thus, then, there are no means of distinguishing by an examination, whether the rupture was really due to violence or spontaneous causes. Those who are unacquainted with this fact, might be disposed to refer the rupture to disease, on the supposition that violence would be indicated by the usual characters externally; but the following cases will show that this view is erroneous.

During a quarrel one man struck another a severe blow on the lower part of the abdomen. The latter was carried home, confined to his bed, and died in seven days. On inspection, there were only a few superficial excoriations on the skin of the abdomen. The bladder was found ruptured to the extent of two inches in its upper and back part; it was highly inflamed. Throughout the abdomen there were the marks of general peritoneal inflammation, of which the man had died. There was a sanguineous fluid effused, exhaling a strong ammoniacal odour. The person who inflicted the blow was convicted of culpable homicide. (Ann. d'Hyg. 1836, 207.) Some doubt seems to have been thrown on the correctness of the medical opinion, that the rupture had been caused by a blow, because there was no ecchymosis or other marks indicative of a severe blow over the region of the bladder. The witnesses properly answered, that ruptures of the viscera of the abdomen from violence, were not necessarily attended with the marks found in injuries to other parts, owing to the yielding and elastic nature of the parietes. One mentioned a case that had recently occurred to him, where a soldier had received in the abdomen, a kick from a horse, which had ruptured the small intestines, and caused death; but there was not the slightest trace of violence externally.

The next case is that of the King against Eccles, tried at the Lancaster Lent Assizes, 1836.

The prisoner, who was half intoxicated, met the deceased in the high road, and without receiving any provocation, gave him a violent kick in the lower part of his abdomen. The deceased turned sick; he attempted to pass his urine, but could not; he was conveyed home, and died from peritonitis in five days. On inspection, there was no ecchymosis, or other injury to the skin indicative of external violence, but the bladder was found ruptured, and the contents extravasated. The rupture was attributed to the blow inflicted by the prisoner. In the defence, it was urged with great plausibility, that as there was no mark of a blow, the rupture might have occurred spontaneously from simple over-distension. The judge in summing up, observed that if the rupture were thus occasioned, it was extraordinary that it should have happened immediately after a violent blow had been struck on the part. The distension of the organ might, however, have rendered the blow more dangerous than it otherwise would have been. The prisoner was convicted.

As an attempt may always be made on these occasions to refer a rupture of this organ to natural causes, it may be observed that this is a very unusual occurrence; a rupture is almost always the result of violence directly applied to the part while the organ is in a distended state. A spontaneous rupture may, however, occur. 1. When there is paralysis, and a want of power to expel the urine; 2, when the bladder is ulcerated or otherwise diseased; 3, when there is an obstruction in the urethra from stricture or other causes. These causes of spontaneous rupture are easily recognizable by ascertaining the previous condition of the deceased, or examining the bladder and urethra after death. If a man were in good health prior to being struck,—if he suddenly felt intense pain, could not pass his urine afterwards, and died from an attack of peritonitis in five or six days; if after death, the bladder was found lacerated, but this organ and the urethra otherwise in a healthy condition, there can be no doubt that the blow was the cause of rupture and death. In such a case, to attribute the rupture to spontaneous causes, would be equal to denying all kind of causation. As to the absence of marks of violence externally, this would only be a difficulty to those who had not previously made themselves acquainted with the facts attending this accident. Nevertheless, the medical witness must be prepared to hear the same line of defence continually urged; it is the object of a counsel to make the best of a case for the prisoner, and his duty consists in seeing him judged according to law, and not condemned contrary to law; with medical facts, opinions, and doctrines he has no concern, so long as they do not serve his purpose.

A diseased state of the bladder might probably diminish the responsibility of an accused person for the consequences; therefore, the state of this organ should be closely looked to on these occasions. From the summing up of the judge in the last case, it might be inferred, that the fact of the bladder being distended at the time of the blow, would be held a mitigatory circumstance; but we can hardly suppose that such would be the opinion of our judges. The fact is, this most serious injury is never liable to occur from violence, except when the bladder is actually distended, which is occasionally its natural condition. If there were anything unnatural or abnormal in the bladder containing urine, such a rule might, perhaps, apply; but as it is not so, the rule would hold out to persons a ready means of certainly destroying life without subjecting them to the same degree of responsibility as if they caused death in other ways.

Can the bladder be ruptured by an accidental fall, and if so, by what kind of fall? The following case reported by Mr. Syme, of Edinburgh, will show that this accident may readily occur.

A woman, aged twenty-six, fell forwards over the edge of a tub, and fainted immediately. On recovering herself, she complained of intense pain in the abdomen, with inability to pass the urine. Peritonitis came on, and she died in a week. On inspection, a small aperture was found in the fundus of the bladder; the peritoneum was extensively inflamed from the urine which had become effused. The ruptured surfaces had become partly glued together. (Ed. Med. and Sur. Jour. Oct. 1836.)

This accident is liable to occur in females during parturition, owing to the pressure of the child's head, an occurrence which may fix a charge of malapraxis on the medical attendant. He is expected to know the probability of such an accident occurring, and to guard against it, if necessary, by the frequent use of the catheter. A surgeon was a few years since tried on a charge of this kind. It is important to remember, that although rupture of the bladder is commonly attended with intense pain, sickness, and prostration of strength, yet individuals may occasionally retain the power of exerting and moving themselves after the accident. (See cases, antè, p. 373.)

In punctured and incised wounds of the bladder, the urine is immediately extravasated, but in gun-shot wounds, the extravasation does not commonly take place until the sloughs have separated. Thus, life may be protracted longer in cases of gun-shot, than under other wounds of the bladder. Barzellotti relates the case of a medical student, shot through the bladder in a duel, who did not die until the twentieth day from the peritonitis which supervened on the extravasation. (Questioni di Med. Leg. t. iii. 174).

For the discovery of extravasated liquids or blood in wounds, and other injuries to the abdominal viscera, we must look to the cavity of the pelvis, as it is here that for obvious reasons such liquids have a tendency to collect.

THE GENITALS.—Wounds of these organs do not often require the attention of a medical jurist; such wounds, whether in the male or female, may, however, prove fatal to life by excessive hæmorrhage. Self-castration or mutilation is not unfrequent among male lunatics and idiots. An inquest was held some time since in London, upon an idiot, who had bled to death from a wound of this description. When timely assistance is rendered, a fatal result may be averted.

In April 1836, a man in a fit of insanity excised his penis and testicles, wrapped them up in an old handkerchief, and put them into his pocket. He was found lying bleeding and exhausted, and was immediately conveyed to St. George's Hospital, where he ultimately did well.

Incised wounds to the female genitals may prove fatal by hæmorrhage, not from the wound involving any large vessel, but from the great vascularity of the parts. Two females were in this way murdered in Edinburgh, some years since. The wounds were inflicted by razors, and the women bled to death. (See cases by Watson, p. 104.) This crime appears to have been at one time frequent in Scotland. When deeply incised wounds are inflicted upon the genital organs of either sex, the fact of their existence in such a situation, at once proves wilful and deliberate malice on the part of the assailant. Accident is wholly out of the question, and suicide is improbable, except in cases of confirmed idiocy and lunacy. Such wounds require to be carefully examined; for the proof of the kind of wound, when fatal, may be tantamount to the proof of murder.

CHAPTER XL.

FRACTURES AND DISLOCATIONS.

These injuries have some important bearings in relation to medical jurisprudence. Fractures may result from falls, blows, or the spontaneous action of muscles. Questions are sometimes put as to whether a particular fracture was caused by an accidental fall or a blow; and if by a blow, whether by the use of a weapon or not. It is obvious that the answers must be regulated by the circumstances of each case. In examining a fracture, it is important to determine, if possible, whether a weapon has been used or not, and this may be sometimes known by the state of the parts. It is a common defence on these occasions, to attribute the fracture to an accidental fall. Fractures more readily occur from equal degrees of force in the old, than in the young; and in the young rather than in the adult; because, it is at this period of life that the bones possess their maximum degree of firmness and solidity. The bones of aged persons are sometimes very brittle, and slight violence will then produce fracture. This is looked upon by our judges as an extenuating circumstance, where the fracture is followed by death. Certain diseases also render bones more fragile; this has been observed in syphilis, arthritis, cancer, scurvy, and rachitis. In such cases, a defence might fairly rest upon an abnormal condition of the bones, provided the violence producing the fracture, was slight. Two trials have lately taken place where this fragility of the bones became a subject of discussion.

But the fracture may be attributed to spontaneous causes, even supposing there are no well-marked signs of disease. Thus, bones have been fractured by violent muscular exertion. The olecranon, os calcis and patella are particularly exposed to this accident. The long bones are very seldom the subject of an accident of this kind; but the os humeri has been thus broken. Mr. May reports the case of a young lady, who fractured the neck of the scapula by suddenly throwing a necklace on her neck. (Med. Gaz. Oct. 1842.) It is probable that in all these instances, if the bone were closely examined, it would be found to have undergone some chemical change in its composition, whereby it was rendered brittle. In cases of this kind, there would be no abrasion of the skin, or any appearance to indicate that a blow had been struck, while the marks of a blow would, of course, remove all idea of the fracture having had a spontaneous origin.

Fractures are not *dangerous to life,* unless when of a compound nature, they occur in old persons, or in those debilitated by disease or the result of dissipated habits. They may then cause death by inducing irritative fever, erysipelas, gangrene, tetanus, or delirium tremens.

It is not always easy to say, whether a fracture has been produced *before or after death.* A fracture produced shortly after death, while the body is warm, and another produced shortly before death, will present much the same characters, except, perhaps, that in the former case there would be less blood effused. One caused ten or twelve hours before death, would be indicated by copious effusion of blood in the surrounding parts, and between the fractured edges of the bones; or if for a longer period before death, there may be the marks of inflammation. Fractures caused several hours after death, are not accompanied by an effusion of blood. A medical witness may be asked, how long did the deceased survive after receiving the fracture? This is a question which can only be decided by an examination of the fractured part. Unless the individual has survived eighteen or twenty-four hours, there are commonly no appreciable changes. After this time, lymph is poured out from the surrounding structures. This slowly becomes hard from the deposition of phosphate of lime, and forms what is called "callus." In the process of time, this acquires all the hardness of the original bone. The death of a person may take place during these changes, and a medical man may be required to state the period at which the fracture probably happened, in order to connect the violence with the act of a particular person. Unfortunately, we have no satisfactory data, if we except the extreme stages of this process, upon which to ground an opinion. We can say whether a person lived for a long or a short time after receiving a fracture, but as to specifying the exact time,—that is clearly impossible; since this process of restoration in bone varies according to age, constitution, and many other circumstances. In young subjects, bones will unite rapidly, in the old slowly; in the diseased and unhealthy, the process is very slow, and sometimes does not take place at all.

According to Villermé, the callus assumes a cartilaginous structure in from sixteen to twenty-five days; and it becomes ossified in a period, varying from three weeks to three months. It requires, however, a period of from six to eight months for the callus to acquire all the hardness, firmness, and power of resisting shocks, possessed by the original bone. A force applied to a recently united bone, will break it through the callus, or bond of union, while after the period stated, the bone will break as readily through any other part. It is generally set down, that the period required for the union of a simple fracture, is, in the thigh-bone six weeks; in the tibia, five weeks; in the os humeri, four weeks; and in the ulna and radius, three weeks; in the ribs, about the same period; but cases have been known where the ribs had not perfectly united in two months, and in some of the other bones, union had not taken place in four months.

Has a bone ever been fractured? This question is sometimes put in reference to the living subject. It is well-known that a bone seldom unites so evenly, but that the point of ossific union is indicated by a node or projection. Some bones are well placed for this examination, as the radius, the clavicle, and tibia,—these being but little covered by skin; in others, the detection is difficult. It is impossible for us to say when the fracture took place; it may have been for six months or six years, since, after the former period, the bone undergoes no perceptible change. These facts are of importance in relation to the dead; since they will enable us to answer questions respecting the identity of skeletons found under suspicious circumstances; and here medical evidence may take a wider range, for a fracture in any bone, may be discovered, if not by external examination, at least by sawing the bone through the suspected broken part, when, should the suspicion be correct, the bony shell will be found thicker and less regular in the situation of the united fracture, than in the normal state. So, in such cases, it will be easy to say whether a fracture is recent or of old standing.

In the case of Clarke, who was murdered many years since by Eugene Aram, the traces of the fracture and indentation of the temporal bone, were plainly distinguished on the exhumation of the skeleton of the deceased, thirteen years after the perpetration of the murder. The manner in which the murder was committed was confessed by an accomplice, and the medical evidence corroborated this confession. An instance of the utility of this kind of knowledge came out on the trial of a gentleman in India, for the murder of a native, Meer Khan, in 1833. There was some reason to suppose, that the prisoner had been falsely accused of causing the death of the native. Two witnesses deposed that a few hours before the deceased died, the prisoner had struck him several blows on the chest, and had broken his ribs. The alleged murder having taken place some months previously to the trial, a skeleton was produced as being that of the deceased, by one of the persons who had assisted in burying him. On examining the ribs, the medical witness found that only one rib was broken, and the fractured portions were united by a firm osseous callus. He, therefore, declared, that the fracture could not have been caused a few hours before death; but that it must have existed for a period of at least eight or twelve days. Hence, the account given by the witnesses, was rendered improbable; for the prisoner had used no violence to the deceased, except just before his death; the fracture, therefore, must have taken place from another cause some time previously.

The witness much understated the period at which the fracture probably occurred; for ossification only commences in the cartilage about the sixth day; and the specks of bony matter continue to increase from the eighth to the twelfth day, but the union is soft, and it is some weeks before the callus becomes perfectly firm and hard.

With respect to the power of locomotion after a fracture, it may be observed, that where the injury is in the upper extremity or in the ribs, unless many of them be broken, an individual may move about although unfitted for great exertion. Fractures of the lower extremity incapacitate a person from moving except to very short distances. See case by Syme, Ed. Med. Jour. Oct. 1836.

Dislocations.—These accidents are not very frequent in the old or in those persons whose bones are brittle. They rarely form a subject for medico-legal investigation. A witness is liable to be asked, what degree of force, and acting in which direction, would produce a dislocation,—a question not difficult to answer. They are not dangerous to life, unless of a compound nature, when death may take place from secondary causes. A dislocation in the living body would be known after death by the copious effusion and coagulation of blood. For a good account of the post-mortem appearances four days after a dislocation of the humerus, see Med. Gaz. xxxi. 266. If of old standing, a dislocation would be identified by the cicatrices in surrounding structures. Dislocations may occur from natural causes, as from disease and destruction of the ligaments in a joint, also from violent muscular spasm during an epiliptic convulsion. Dr. Dymock met with an instance of dislocation of the humerus forwards during puerperal convulsions.—(Ed. Med. Jour. April, 1843.)

Locomotion may exist except when the injury is in the lower extremity, and even then it has been observed, that for some time after a dislocation of the hip joint, considerable power over the limb remains; it is only after a few hours, that it becomes fixed in one position. Exertion with the dislocated member, is, in all cases, out of the question.

There are certain fractures of an obscure kind which closely resemble dislocations. This has been pointed out by Sir A. Cooper, in relation to fractures through the anatomical neck of the os humeri. (Guy's Hosp. Rep. ix. 272.) This accident might be easily mistaken for a dislocation. In attempting to reduce the bone, the head continually falls back into the axilla. In such a case, an action for malapraxis might be brought against a surgeon, and heavy damages recovered. It could only be by a dissection of the part after death, that the real nature of the case would be ascertained. It is requisite, therefore, that great caution should be used in the diagnosis. The same observations apply to fractures of the neck of the thigh-bone, although with less force, because this is a much more common accident.

It is well known, that fractures and dislocations, when cured, are often attended either with some slight deformity in the limb, or with some impairment of its functions. This result is sometimes inevitable under the best treatment; but it is commonly set down as a sign of unskilfulness in the medical attendant. Actions for malapraxis are instituted, and in spite of good evidence in his favour, the surgeon is sometimes heavily fined for a result which could not be avoided. There is often great injustice in these proceedings, and the mischief can only be remedied by referring the facts to a medical tribunal, which alone should be competent to decide whether or not unskilfulness had really been shown in the management of the case.

CHAPTER XLI.

GUN-SHOT WOUNDS.

Gun-shot wounds are of the contused kind, but they differ from other wounds, in the fact that the vitality of the parts struck by the projectile is destroyed, leading ultimately to a process of sloughing. The legal definition of a wound applies here, as in other cases, so that in order to constitute a gun-shot wound within the meaning of the statute, the cutis must be injured. In the case of the Queen against Mortlock, tried at the Cambridge Lent Assizes, 1843, the surgeon deposed that there was a circular wound on the skin, by which it had been deprived of its cuticle, but the true skin was not penetrated. The bullet had struck obliquely at a very considerable angle; had it been otherwise it must have entered the abdomen. The judge said that as the true skin was not penetrated, there was no wounding within the meaning of the statute.

The medico-legal questions which arise out of gun-shot wounds, are much the same as those which have been examined in relation to other wounds. They are very dangerous to life, more especially when they penetrate or traverse any of the great cavities of the body. Death may take place directly from hæmorrhage or shock; although immediate or copious hæmorrhage is not a common character of these injuries. Death from shock is occasionally witnessed. In the case of the policeman Daly, who was killed by a pistol-bullet in Hornsey Wood, May, 1842, it was found, on inspection, that the bullet had traversed the distended stomach at the cardiac end from behind forwards. The two apertures were about the size of a shilling, and the edges black. There was but little blood effused, and the other viscera were uninjured. The deceased died in a few seconds after receiving the wound, obviously from a shock to the nervous system. (Lancet, May, 1842.) Indirectly, these wounds are attended with much danger:—sloughing generally takes place uniformly throughout the whole of the perforation, and inflammation or fatal hæmorrhage may cut short life. If the individual survive the first effects he may die at almost any period from suppurative fever, erysipelas, gangrene, or from the results of operations absolutely required for his treatment. Gun-shot wounds may thus destroy life after very long periods of time. Marshal Maison, one of Napoleon's generals, died in Paris in 1840, it is said from the effects of a gun-shot wound received forty years before.

In gun-shot wounds of a severe kind, the first symptoms do not always indicate the degree of mischief. This was seen in the case of Mr. Drummond, who was shot by M'Naughten, in January, 1843. The symptoms were in the first instance so slight, that the bullet was supposed not to have penetrated the cavity of the abdomen; but to have coursed round the skin. Death took place in a few days, and it was then found that the bullet had completely traversed the abdomen, perforating the diaphragm. Army surgeons have also remarked that slight wounds of the parietes are often insidiously attended with deep-seated injury. Death might in such a case be improperly ascribed to mismanagement, when it may have been really due to the wound. (See cases by Mr. Alcock, Med. Gaz. xxiv. 850.) It is not easy to mistake a gun-shot wound for any other injury. If the circumstances under which it is produced, do not satisfactorily account for its origin,—a simple examination will suffice to show its true nature. Sometimes the projectile is found lodged in the wound.

A medical witness may be asked, whether the wound was inflicted *before or after death*. It is by no means easy to answer this question, unless the bullet has injured some vessel, when the effusion of blood, and the formation of coagula, will indicate that the person was living when it was received. In a gun-shot wound on the dead, no blood is effused, unless the bullet happen to strike a vein. A very frequent question is, whether the wound was caused by a bullet fired near or from a distance. A gun-shot wound produced by the muzzle of the piece being placed near to the surface of the body, has the following characters. There may be two apertures, the one of entrance and the other of exit; but it sometimes happens that the bullet lodges and does not pass out. The edges of the aperture of entrance appear blackened, as if they had been burnt, arising from the heat and flame of the gunpowder at the moment of explosion. The skin is often ecchymosed, and is much blackened by the powder:—the clothes covering the body are blackened by the discharge, and sometimes ignited by the flame. If the muzzle of the piece was not in immediate contact with the part struck, the wound is rounded; but if there has been direct contact, the skin, besides being burnt, is torn and much lacerated. The hæmorrhage is usually slight, and when this occurs it is more commonly from the orifice of exit, than from that of entrance. It should be observed, that the aperture of entrance is round, only when the bullet strikes point-blank or nearly so. If it should strike obliquely, the orifice will have more or less of an oval or valvular form, and in this way we may sometimes determine the relative position of the assailant with respect to the wounded party.

Supposing the bullet to have been fired from a moderate distance, but so near as to have had sufficient momentum to traverse the body, then the appearances of the wounds will be different. The orifice of entrance will be well defined, round or oval, according to the circumstances,—the skin slightly depressed inwards,—the edges presenting a faint bruised appearance, but the surrounding parts are neither blackened or burnt, nor do they present any marks of hæmorrhage. In all cases the orifice of exit is large, irregular, the edges somewhat everted, and the skin lacerated but free from all marks of blackness or burning: it is generally three or four times as large as the entrance-aperture. This is denied, but to me it appears upon insufficient evidence, by Dr. Malle, Ann. D'Hyg. 1840, 458. The orifice of entrance is, however, always large and irregular, when the bullet strikes near the extremity of its range. Under common circumstances, the entrance-aperture has generally the appearance of being smaller than the projectile, owing to the elasticity of the living skin. It is the same with the aperture in the dress, when this is formed of an elastic material:—according to Dupuytren, the hole in the dress is always smaller than that made by the bullet in the integuments. These points should be remembered in fitting projectiles to wounds which they are supposed to have produced.

Useful evidence may be sometimes obtained by a careful examination of the projectile, the identity of which should be preserved by the medical witness. In the case of the King against Howe and Wood, Stafford Lent Assizes, 1813, it was proved that the deceased had died from a gun-shot wound in the back. The bullet extracted from the wound was found to have been discharged from a pistol with a screw-barrel. A weapon of this kind was found on the prisoner, as well as a bullet, which had evidently been cast in the same mould as that taken from the body of the deceased. (Will's Circ. Evidence, 264.) On these occasions, the medical attendant should either keep possession of any of the projectiles, which he may remove from a wound, or deliver them only into the hands of responsible persons.

An examination of the dress alone will sometimes enable us to give an opinion as to where the bullet has passed in, and thus to form a judgment of the direction in which the shot was fired. If a ball strikes at a moderate distance, the aperture in the dress where it enters, is round, and the margin is regularly defined; but the aperture by which it passes out is irregular and torn. In the case of a friend who was wounded in Paris during the revolution of 1830, the ball traversed the left arm :—it had taken out a circular piece of the coat, shirt, and undershirt, where it had entered; but it produced a large irregular opening where it had passed out. Other opportunities occurred to me of verifying the correctness of this remark. Sometimes portions of the dress are carried into the wound,—or if the ball be nearly spent, the dress is elongated like a pouch into the wound. By putting the edges of the cloth together where the bullet has passed in, it may be seen whether any of the cloth has been carried before it. The holes are generally ragged, but the nearer the wounded person is to the assailant, the more perfect is the hole in the dress,—provided the piece be not discharged in immediate contact. The bruised and dark appearance which a gun-shot wound sometimes presents, even when the piece is discharged at a distance from the body, led to the supposition that this effect was due to a burn; and that the bullet burnt the parts which it touched; but this idea has been long exploded. The projectile never becomes sufficiently heated, to acquire the least power of burning.

The question whether a piece was fired near to or at a distance from the wounded party, may become of material importance on a charge of homicide. Two persons may quarrel, one having a loaded weapon in his hand, which he may allege to have been accidentally discharged, and to have killed the deceased. If the allegation be true, we ought to find on the body the marks of a near-wound: if, however, it were such as that it had been produced from a distance, and therefore after the quarrel,—the medical proof of this fact might imply malice, and involve the accused in a charge of murder. The following case occurred in Ireland in 1834 :—

A tithe-collector was tried for the murder of a man, by shooting him. It appeared in evidence, that the prisoner, while on duty, was attacked by the deceased and two of his sons, and he drew a pistol to intimidate them. He was dragged off his horse by these parties, and during the scuffle, it is supposed, the pistol accidentally went off, and inflicted a wound on the deceased, of which he died shortly afterwards. The sons of the deceased swore that the prisoner, when at some distance, took a deliberate aim, and fired the pistol at their father; and a priest came forward to depose, that such was the dying declaration of the deceased. From some subsequent suspicion of the truth of this story, the body, which had not been properly inspected in the first instance, was ordered to be disinterred. It was carefully examined by a surgeon, who was enabled to swear positively, that the pistol must have been fired close to the body of the deceased, and not at a distance; since there were the marks of powder and burning on the wrist. Hence it clearly followed, that the pistol had been discharged during the scuffle, either by accident or in self-defence. The prisoner was acquitted, and the parties who had appeared as witnesses against him, were indicted and convicted of perjury.

In the case of Mr. Pearce, a surgeon who was tried at the Central Criminal Court, in 1840, for shooting at his wife, and was found insane, it appeared from the medical evidence that the pistol had been fired so near to the person of the prosecutrix, that her dress was burnt and the skin blistered. Mr. Marshall relates that when stationed at Ceylon with troops, a man who had but recently joined the regiment, was placed as sentry in a position, where he was occasionally fired at by the enemy from the surrounding jungle. The man was one day found severely wounded; the calf of his leg was greatly torn ; the whole charge of a musket having passed through it. He attributed the wound to a shot from the enemy, but from the skin of the leg being completely blackened by charcoal, it was clear that it must have arisen from the discharge of his own musket. He had inflicted this wound upon himself, in order to obtain a discharge from the regiment. These examples then show, that both the dress and skin of a person who has received a gun-shot wound should be closely examined. The result may be, that the statement given of the mode in which it was received, will be entirely disproved.

The case of M Peytel, tried in France, in September 1839, presents many points of great interest in relation to the medical jurisprudence of gun-shot wounds. This gentleman was travelling in a carriage, in company with his wife, and attended by a man-servant. The wife and the man-servant were found dead on the road, and the account given by M. Peytel, was, that the servant had discharged a pistol into the carriage, and shot his wife, and he had afterwards pursued and killed him. The facts, however, were so suspicious against M. Peytel, that he was charged with the double-murder. From an examination of the body of the wife, it appeared, that there were two pistol wounds in the face, which had most probably been produced by two separate pistols. The prisoner alleged, that about nine o'clock at night, when it was dark, he desired the servant to get down in order to relieve the horses. Two minutes afterwards, some man, whom he afterward found to be the servant, approached the carriage-door, discharged a pistol at him, and wounded his wife ; but the evidence showed that two weapons must have been used, or at least two different discharges made by a person sitting very near to the deceased, so that the muzzles must have almost touched her face, the eyelashes and skin having been much burnt by the powder. These facts, together with other strong circumstances against him, led to the prisoner's conviction. Dr. Ollivier, who appeared in the prisoner's favour, considered that the deceased might have been shot by the servant, and that the two wounds might have been produced by one pistol loaded with two bullets; also, that the marks of burning about the face of the deceased, might be attributed to the wadding, and therefore they afforded no proof that the muzzle of the pistol had, at the time of its discharge, been close to her person. He also contended that the deceased had not died from the wounds. Notwithstanding these ingenious medico-legal arguments, there can be no doubt that the prisoner was very properly convicted. (See Ann. d'Hyg. 1839, p. 339.)

It has been said, that when a bullet is fired near, it commonly traverses ; and therefore it has been rather hastily assumed, that where there is only one external wound, and the bullet has lodged, this is a proof that the piece has been fired from a distance. This inference is, however, erroneous. A bullet may be fired close to the person, and yet not traverse the body, either from its impulsive force not being sufficiently great, or from its meeting with resistance in the body. Many cases might be cited to show, that in the near wounds produced by suicides and murderers, the bullets have not always traversed the body. In suicide, when the piece is discharged into the mouth, the projectile often lodges in some part of the cranium. In the late assassination of Mr. Drummond, the pistol was discharged close to the back of the deceased ;—the ball, however, had not traversed, it had lodged beneath the skin in the fore-part of the abdomen. It is then, it appears to me, out of the power of a witness to say, from the mere fact of a bullet lodging or traversing, whether the assassin was far off or near at the time the deceased was wounded. The latter point may be sometimes readily determined by the marks of injury and burning to the skin and dress.

When several wounds are found on a body,—can we determine whether they were produced by one or several different discharges? This question was raised in Peytel's case, as there were two wounds on the deceased, and the prisoner alleged that the servant had fired but one pistol. M. Ollivier thought that this might be explained by supposing that there had been two bullets in the pistol :—it was, however, affirmed by some military officers and other witnesses, that these wounds had been produced by separate pistols, a fact which overthrew the defence of the prisoner. It is proper to remark that one ball may produce several wounds on the body; there will be only one orifice of entrance, but owing to the ball occasionally splitting within the body, and dividing itself into three or four pieces, there may be several orifices of exit. This splitting of balls has repeatedly occurred where the projectile in its course, has encountered an angular surface, or projecting ridge of bone. Dupuytren met with an instance, where a ball, after having struck the ridge of the tibia, divided itself into two parts, which traversed the calf of that leg, and penetrated into the calf of the opposite leg. Thus no less than five wounds were produced in one instance by a single ball; three of entrance and two of exit. Had this man been found dead, and nothing known concerning him, this singular circumstance would probably have given rise to considerable embarrassment. After a careful examination, a surgeon might have been induced to declare, that this person must have received three distinct shots. A similar effect was observed in another case, where a bullet struck the parietal bone and divided itself into two portions :—one passed out superficially through the integuments, the other penetrated into the brain, and lodged on the tentorium. This fact shows, that the discovery of an exit-aperture, does not always prove that the whole of a projectile has passed out, a matter which may influence the prognosis.

It is not absolutely necessary for the conviction of a party on a criminal charge of maliciously shooting at another, that the bullets or shot should be produced, or that they should even have been found on a post-mortem examination of the body. In the case of the Queen v. Cottrell, tried in 1839, the deceased was seen to drop, and his face was covered with blood. On persons going up to him, he was found dead. The medical evidence established, that there was a gun-shot wound in the left eye, leading to the brain, and that this had caused death. The shot could not be found. The prisoner's counsel objected on this ground, that there was no proof of a gun-shot wound having been inflicted: but the judge said, the circumstances were sufficient to warrant the jury in inferring that the deceased had been struck by some substance from the gun, which caused his death; and it was not necessary to prove, whether this had been done by leaden shot or pellets. If it should happen, that no wound was produced by the discharge, there would be a want of evidence as to whether the piece were loaded or not, and the accused would probably escape on this ground, unless he were very near to the party whom he attacked, or the bullet were found. This is a subject which gave rise to much discussion in the case of the Queen against Oxford in 1840. By this case, it seems to have been decided, that the proof of a piece being loaded with ball or shot, is not necessary, provided the prisoner were so near to the party when he fired it, that mischief might have been done by the wadding or gunpowder only. This, as we shall presently find, becomes occasionally a medical question.

When a ball traverses the body, it sometimes happens that the apertures are opposite to each other; although it may not have taken a rectilinear course between them, but have been variously deflected by the subjacent soft parts. This deflection of a ball from a rectilinear course, is especially met with in those cases where it happens to strike obliquely a curved surface, and it is found that where the ball enters and does not pass out, its course is often extremely circuitous, so that it is not always easy to say in what part of the body it may be found.

In 1830, I saw at the Hôtel Dieu, a boy who had received a gun-shot wound in the scrobiculus cordis; the entrance-orifice was very plainly situated there, but there was an opening at the back, nearly diametrically opposite, out of which the ball had passed, so that it conveyed the impression that the ball had completely traversed the abdomen. There was no sign of collapse or depression, nor any indication of serious injury, and Dupuytren gave an opinion which was afterwards verified, that the ball had not penetrated, but had been deflected beneath the skin, and had taken a circuitous course through the cellular membrane to the back. Many similar facts are recorded. The same deflection may occur even when the piece is discharged close to the body, as in cases of suicide. Mr. Abernethy was once called to examine a man, who had shot himself, as it was supposed, through the head. He found two openings in the scalp, nearly opposite to each other; it was soon perceived, on examination, that the ball had not penetrated the bone, but had followed the curve of the exterior of the cranium to its point of exit.

These deflections of projectiles may occur not merely when they come in contact with bone, but when they meet skin, muscles, tendons, and fasciæ,—the ball then takes its course in the interstices between these different structures. A ball which entered at the ankle, has been known to make its exit at the knee: and another, which entered at the back of the left shoulder, passed down on the inside of the scapula, and was found below the right mastoid process. This deflection of balls by such slight obstacles, has been ascribed partly to the obliquity with which they strike, and partly to the rotatory motion on its axis which every spherical projectile is considered to have. It does not appear to be much connected with the degree of velocity, for the same deviation has been found to occur where the bullet was fired near as well as at a distance.

Among the questions connected with this subject is the following.—Whether, when a gun bursts, the projectile would take the direction which it would otherwise have taken, had the piece remained entire? (The King v. Morgan, Monmouth Lent. Ass. 1835.)

The prisoner in this case was charged with having fired at the deceased with intent to murder. The gun burst in his hand, and produced upon his person, wounds, whereby he was subsequently clearly identified. It was alleged in the defence, that the gun might have been pointed in another direction, and that the deceased was killed accidentally by the charge becoming scattered at the time the piece burst. The question was very properly answered in the affirmative, for the bursting of a gun is posterior to the impulsive direction given to the charge. The shot found in the deceased's body, proved that the gun must have been pointed and fired at her deliberately, notwithstanding the accidental bursting of the piece.

In the cases recently tried for the attempts on the life of the Queen, it was asked whether it be possible to determine if a recently discharged gun or pistol had been loaded with ball or not. It is impossible to give an answer to this question, merely by an examination of the weapon. The report, if heard, is said to be louder and sharper in the case of a piece loaded with ball, than where it is charged with gunpowder and wadding only. If a piece were fired in a direction, so that the projectile met with any hard or resisting object,—the fact of a bullet having been used would be, if not the discovery of a flattened projectile, by the trace of a deep leaden mark in the situation of the part struck.

If we can at any time discover two fixed points where the ball has touched a building, without being reflected, it will be easy to determine the situation from which the piece was discharged. A singular example of this kind is stated by Mr. Watson to have occurred at Ayr in 1831. Several shots had been maliciously fired into a church. Some of the bullets traversed a window, making holes in the glass, and struck against a wall on the other side of the church,—a fact plainly indicated by the marks which they left. A straight line carried from these two points, reached a window on the opposite side of the street, from which it was afterwards ascertained the bullets had been fired.

A witness may be asked, when the gun-shot wound was inflicted, and how long the wounded party survived after receiving it. A gun-shot wound undergoes no change for eight or ten hours after its infliction. Our judgment may be assisted by observing what parts are involved, although we cannot always infer from the quantity of blood found near, that the hæmorrhage was an immediate consequence of the wound, or that the whole of the blood was effused at once. We cannot then always deny that the deceased could not have moved or exerted himself in some degree, after receiving it. The exertion thus made subsequently to his being wounded, may actually have caused the fatal hæmorrhage.

When it is doubtful whether the wound was the result of *accident, suicide,* or *homicide,* the point may be often settled by paying attention to the situation and direction of the wound. Suicidal gun-shot wounds are almost always directed to a vital part—to the heart or to the brain: —they possess those characters which belong to wounds inflicted near to the body:—the skin is blackened or burnt, the wound wide and lacerated,—the hand which discharged the weapon, often blackened,—and sometimes still grasping the pistol. The ball may or may not have traversed, as that will depend on the momentum which it derives from the charge. Suicidal gun-shot wounds are seldom situated at the posterior surface of the body, therefore the determination of the point of entrance, if a ball has traversed, is of some importance. The direction of these wounds is probably of less moment than their situation, because the projectile is liable to be deflected.

In a duel which occurred in Paris, in 1827, one of the parties, a tall man, was killed by a ball which was found to have entered below the right shoulder and to have taken a direction downwards. In consequence of this, it was thought, that he had been shot unfairly by his antagonist, who was short in stature. Breschet and others explained the suspicious course of the wound, by saying that the ball had struck the under part of the clavicle, and had thence probably been deflected downwards.

Accidental wounds also bear the characters of near wounds :—they may touch vital parts, but if the body be not disturbed, the presence or absence of design in the infliction of the wound is commonly made apparent by the relative position of the body and the weapon. They frequently arise from persons drawing the charges of guns or pistols with the muzzles pointed towards them; and these are situated in front;—at other times they are produced by persons pulling towards them through a hedge, or dragging after them, a loaded gun. In the latter case the wound is behind, and strongly resembles a homicidal wound, although the circumstances under which the body is found, generally suffice to explain the matter.

In the following case of attempted suicide, the characters of the wound somewhat resembled those which are commonly imputed to homicide. In March 1840, a man was brought to Guy's Hospital, with a large ragged gun-shot wound on the right side of the head, behind the angle of the jaw, and between it and the mastoid process. No slugs or bullets could be found; the direction was from behind forwards, and from above downwards. According to this man's statement, the pistol missed fire three times, but he succeeded in discharging it into his mouth, at the fourth attempt. He lost a large quantity of blood, but after some time, he walked to a table at a distance of five yards reloaded the pistol, and discharged it at the back of his head in the situation described. Thus, then, there were two wounds, one homicidal in its characters, and with a power of locomotion after the first wound in spite of considerable hæmorrhage.

A gun-shot wound in the mouth or temple, would seldom be set down to accident, and yet attempts are occasionally made to ascribe to such wounds an accidental origin.

In April, 1843, an inquest was held on the body of an officer in the army, who was found dead in his bed-room. According to the evidence, the deceased, when found, was sitting on the sofa, his head reclining on one side, and blood appeared to have flowed from his mouth, although his lips were closed. He was partly undressed, and the pistol was discovered in his drawers. On inspection, it was found that the pistol had been discharged into his mouth, the upper jaw was completely shattered, and the ball was extracted from the back part of the cranium. There appeared to be no motive for suicide, and the deceased had retired to his bed-room in his usual health and spirits. The question was: Was this an accidental or a suicidal wound? The coroner required no medical opinion on that point, but adopted the explanation suggested by a friend of the deceased, namely, that in attempting to pull out the ramrod by his teeth, the pistol had become accidentally discharged into his mouth, and a verdict was returned accordingly!

The following case occurred in London, in 1836. A man fastened himself in his bed-room, and was afterwards found lying on the bed, bleeding, but perfectly sensible, with a gun-shot wound on the right temple, just above the ear. A pistol, recently discharged, was lying by his side. He died in a few days, and the account he gave was, that he was going to discharge the pistol into the yard, when he fell with the weapon in his hand, and it accidentally went off, and produced the wound. This explanation was strengthened by a medical opinion, in consequence of the skin about the entrance-orifice being lacerated. The jury, without pronouncing it to be an act of suicide, returned a modified verdict. So far as the facts will allow us to judge, both of the preceding instances appear to have been the result of suicide, and not accidental. It is unfortunate, that such cases are not better investigated by coroners. The verdicts appear in general to be founded on motives of expediency. Had the lives of the deceased been insured, the question of accident or suicide would have become of considerable importance; and the facts must have received a very different kind of investigation.

In suicide there is commonly strong evidence of design: in accident, all evidence of design is wanting. Suicides sometimes make use of extraordinary weapons, or use weapons in an extraordinary manner. In a case that was brought into St. Thomas's hospital, some years since, a young man, employed for the purpose of shooting himself, the case of an Italian iron, in which he had filed a touch-hole. He used a marble for a bullet, and discharged the piece into his mouth. Guns are rarely used by suicides, and when they are employed, the marks of design are commonly apparent:—thus the gun is perhaps found to have been discharged by a piece of string attached to the trigger and the deceased's foot. In one instance a man loaded a gun, and placed the stock and breech in a grate. He then deliberately lighted a fire in the grate, and sat opposite the muzzle. When suicides destroy themselves by guns, the wounds are never situated behind. A wound in the back from a gun, indicates either accident or homicide. Important medical questions sometimes arise out of a case of this kind, for the circumstances under which a dead body so wounded, is found, may entirely forbid the supposition of accident.

In the case of the King against Adams, tried at the Berkshire Assizes, 1836, in which the prisoner was charged with the murder of his father, the gun-shot wound, which had caused death, was situated in the os occipitis. No weapon was found near; hence there could be no doubt, that this was an act of murder. The prisoner was acquitted; since, although he was seen running from the spot at or about the time of the murder, another gun was heard to be discharged, at the same spot about an hour afterwards; and it was impossible, from a medical examination of the wound, to say at what particular period it had been caused. A somewhat similar case occurred recently, (the Queen against Richards, Warwick Lent Assizes, 1843.) The deceased was found dead, lying on his back, with his gun placed on the front of his body, reaching from his thigh to some inches above his head. On inspection, it was ascertained that death had been caused by a severe gun-shot wound at the back of the right ear. Two surgeons of Birmingham, gave it as their opinion, that from the position of the wound, the body and the weapon, death could not have occurred from design or accident of the deceased, but might have taken place from the accident of another. The prisoner was acquitted, as there was insufficient proof to connect him with the act.

Did the deceased receive the shot while standing, falling, or lying down? Was the piece when discharged pointed from the shoulder? These questions can only be answered by reference to the particular circumstances of the case. In general, when a person is shot while standing, and the piece is pointed from the shoulder, the wound is more or less transverse; but due allowance must be made for the deflection of balls after penetration. (The Queen against Magarity, Central Criminal Court, July 1841.) Was the deceased shot while running away, or when approaching the person who fired? This question is answered by observing in the case of a traversing wound, in which alone, any difficulty can arise, whether the entrance-orifice be situated in front or behind. A trial took place at the Kent Assizes some years since in which this question was material.

An officer in the preventive service, was charged with having caused the death of a man, by shooting him. The deceased was in company with a strong party of smugglers, whom the prisoner and his men were pursuing. During their retreat, the companions of the deceased fired on the preventive-service men, and there seemed great reason to believe that he was accidentally killed by one of the shots so fired, he being at the time between them and the pursuers. If, however, this had been the case, it was clear that he must have received the gun-shot wound in front, as he himself was in the act of retreating. On the other hand it was uncertain, from the general evidence, whether be had not been shot by the prisoner; because, although it did not appear that shots had been fired by him or any of bis party, yet it was proved that in running he tripped and fell, and his gun went off at the same instant, so that it was not impossible that the deceased might have received the mortal wound in this manner. The whole case, therefore, rested on the evidence of the medical witnesses. There were two surgeons, who were examined,—one for the prosecution, and the other for the defence. The witness who appeared for the prosecution, deposed, that he found the body of the deceased traversed by a gun-shot wound, which had caused death from the laceration of an artery, and the consequent hæmorrhage. One of the orifices of the wound was situated in the lower part of the buttock, and the other in the upper part of the groin, so that the latter was higher up than the former. He made an inspection of the body, and, in his judgment, the ball had passed through the the bones of the pelvis, from behind. According to the opinion of this witness, therefore, the prisoner must have caused the death of the deceased. For the defence, a surgeon in the navy, who, it appeared, had had considerable experience relative to gun-shot wounds, was called. He stated that he examined the body of the deceased, in the presence of the first witness, but he was of opinion that the ball had entered in front, and passed out behind the body. The reasons which he assigned for this opinion were, that the wound in front was much smaller than that situated behind, and its edges were smooth and depressed, or turned inwards; while the opening behind was twice or three times the size of that before, and was ragged and uneven, the fragments of bone lying about the opening, and being partly lodged in the muscles of the buttock. These facts proved to him, most unequivocally, that the ball had entered in front, having, with diminished impetus, torn itself out posteriorly. If the ball had entered from behind, he should have expected that the fragments of bone would not have been carried upwards and inwards into the pelvis, and would not have been lodged about the buttock. The value of this witness's evidence was most materially affected by the cross-examination which he underwent. He then stated, that he did not make an inspection of the body until after it had been already inspected, and sewn up. He did not see the state of the bone itself, and his examination of it was but slight. He admitted that the openings of the wound afford better evidence than the state of the bone; as also that the bone would certainly be shattered, where-the ball had entered. They both agreed, in the first instance, that the ball had entered in front. No reason was assigned why his evidence afterwards differed so materially from that of his colleague.

Dr. Smith, who reports this case, does not say what was the result, and we are, therefore, left in doubt upon which of the two witnesses' opinions the verdict of the jury was based; but if the prisoner was found to have caused the death of the man, it would have been, upon the evidence, no more than misadventure. The view of the latter witness was, most probably correct, namely, that the ball had entered in front, and that he was shot by his own party;—because the reasons assigned by him, were satisfactory and consistent with all experience on the subject; but his opinion was invalidated by the admission that he had made but a superficial and imperfect examination of the body; as also that he did not see it until it had been inspected, and, therefore, not until the parts had been interfered with by others. The direction of the wound,—its passing from above downwards, and from before backwards, also throws a shade of doubt upon its correctness: since, for the shot to have been fired in front, the individual who fired it, must have been much elevated above the deceased, a circumstance which did not appear from the evidence, or a ball could not have taken such a course; while, on the other hand, its direction was precisely such as it would have taken, if it had been discharged from the prisoner's gun, since it was established by the evidence, that he, the prisoner, had fallen while pursuing, and his gun had become then accidentally discharged.

Death is sometimes occasioned by small shot, and here several medico-legal questions present themselves. Small shot may act in two ways; 1, it either strikes without spreading, in which case, the discharge is always near the person, and its action is much more dangerous, than that of a single ball, because it produces extensive lacerations; or, 2nd, it strikes after it has spread, and here the discharge must have been distant, and comparatively little mischief is done. Dr. Lachése ascertained by many experiments, that in order to produce with small shot, a regularly round opening like that resulting from a bullet, the discharge should not take place at a distance greater than ten or twelve inches from the surface of the body. When the distance was from twelve to eighteen inches, the opening made was irregular, and the borders were much lacerated; at thirty-six inches, a central opening was entirely lost, and the surface of the body was covered by shot. The effect after this was found to depend on the distance, the goodness of the gun, and the strength of the charge; (Ann. d'Hyg. 1836, 386;) but it is in general much scattered over the surface of the body. In this way, we may form an opinion of the distance at which the piece was fired.

In the case of the Queen v. Chapman, (Oxford Lent Assizes, 1839,) it was proved, that the deceased had been killed by small shot fired from a gun; that the discharge must have taken place very near, as the shot had not been scattered, and the point of the gun must have been below the level of the wound, as the direction was rather upwards. Two medical witnesses were examined, and both agreed, that the gun, when fired, could not have been pointed from the shoulder, judging from the direction of the wound. It can rarely happen that a circular wound can be made by small shot without the dress being singed or burnt. A wound of this description must not, however, be mistaken for one produced by a bullet.

Small shot is rarely observed to traverse the body entirely, unless found so near, as to make a clean round opening; but a single pellet reaching the body may destroy life. Two cases have already been mentioned, one where a young man was killed by a single pellet wounding the fifth intercostal artery, the other where a young girl was killed by a pellet traversing the orbitar-plate and wounding the brain. Such minute wounds might be easily overlooked in an examination of the body. Small shot, even when wounding only the skin of the back superficially, has caused death by tetanus.

It matters not with what the piece is charged,—it is capable, when fired near, of producing a wound which will prove fatal. Thus, a piece loaded with wadding, or even gunpowder only, may cause death. In all these cases, an impulsive force is given by the explosion ; and the substance becomes a dangerous projectile. The lighter the projectile, the shorter the distance to which it is carried ; but when discharged near to the body, it may produce a fatal penetrating wound. It is unfortunate, that so much ignorance prevails on this point; for fatal accidents are continually occurring from persons discharging guns at others in sport,—an act which they think they may perform without danger, because they are not loaded with ball or shot.

In the case of the Queen against Race, (Bury Lent Assizes, March 1840,) it was proved, that the prisoner had killed the deceased by discharging at him, within a few feet, a gun loaded with powder and paper-wadding. This was done out of joke at a fair. The deceased fell, and died in a few minutes : it was found, that the chest was penetrated, and that the wadding had wounded the left auricle of the heart.

In October, 1836, during a boat-race at Greenwich, a gentleman fired a blunderbuss towards a crowd of persons. The piece was charged with powder, and this was rammed down with a kid glove having a metallic button attached to it. A man standing on the shore, at the distance of ten or twelve feet received the charge in his abdomen. The deceased died in twelve hours from hæmorrhage:—the glove was found in the abdomen. In 1838, a girl was killed at Burton-upon-Trent by some boys discharging at her a gun loaded with paper-pellets. Some of these penetrated the body and lodged in the lungs and liver. Dupuytren mentions an instance where, during a quarrel between two men, one discharged at the other, a gun loaded with powder and wadding only, at a distance of about eighteen inches. The man instantly fell dead :—on inspection, his clothes were found torn,—the intestines were lacerated, blood was effused, and the wadding was lodged in the abdomen.

It has been observed, that persons, in attempting to commit suicide, have occasionally forgotten to put a bullet into the pistol ; nevertheless, the discharge of the piece into the mouth, has sufficed from the effect of the wadding only, to produce a considerable destruction of parts, and to cause serious hæmorrhage. Fatal accidents have frequently taken place from the discharge of wadding from cannon during reviews. It is not easy to say, at what distance a weapon thus charged with wadding and powder, would cease to produce mischief, since this must depend on the impulsive force of the powder and the size of the piece. Dr. Lachèse has ascertained by experiment, that a piece charged with gunpowder only, without wadding, is capable of producing a penetrating wound somewhat resembling that caused by small shot, when the piece is large, strongly charged with powder, and fired within six inches of the surface of the body. This arises from a portion of the powder always escaping combustion at the time of discharge, and each grain then acts like a pellet of small shot. Under any circumstances, a discharge of powder only contuses the skin, producing ecchymosis, and often lacerating it, if the piece be fired near. The dress is burnt and the skin scorched from the globe of flame formed by the combustion of the powder ; many of the surrounding particles may be actually driven into the cutis. All the substances here spoken of are considered to be projectiles; and the weapons are held in law to be loaded arms, so long as they are capable of producing bodily injury at the distance from which the piece containing them, is discharged.

Among the singular questions which have arisen out of this subject, is the following : Whether a person who fires a gun or pistol at another during a dark night, can be identified by means of the light produced in the discharge? This question was first referred to the class of physical sciences in France, in 1809, and they answered it in the negative. A case tending to show that their decision was erroneous, was subsequently reported by Foderè. A woman positively swore that she saw the face of a person, who fired at another during the night, surrounded by a kind of glory, and that she was thereby enabled to identify the prisoner. This statement was confirmed by the deposition of the wounded party. Desgranges, of Lyons, performed many experiments on this subject: and he concluded that on a very dark night, and away from every source of light, a person who had fired the gun might be identified within a moderate distance. If the flash were very strong, the smoke very dense, and the distance great, the person firing the piece could not be identified. This question was raised in this country, in the case of the Queen v. White, at the Croydon Autumn Assizes, 1839.

A gentleman was shot at while driving home in his gig during a dark night. He was wounded in the elbow. When he observed the flash of the gun, he saw that it was levelled towards him, and the light of the flash enabled him to recognize at once the features of the accused :—in cross-examination he said he was quite sure he could see him, and that he was not mistaken as to his identity. The accused was skilfully defended and he was acquitted.

Evidence of this kind has, however, been received in an English court of law. A case is quoted by Paris and Fonblanque, (Rex v. Haines,) in which some police-officers were shot at by highwaymen during a dark night. One of the officers stated that he could distinctly see, from the flash of the pistol, that the robber rode a dark brown horse of a very remarkable shape in the head and shoulders ; and that he had since identified the horse, at a stable in London. He also perceived by the same flash of light, that the person had on a rough brown great coat. This evidence was considered to be satisfactory.

From the information which I have been able to collect on this point it appears to me there can be no doubt, that an assailant may thus be occasionally identified. It is widely different, however, in respect to the following case referred to by Müller in his Physiology; namely, where a man declared, that he recognized a robber through the light produced by a blow on his eye in the dark! As Müller observes, this is a clear impossibility; because the flashes thus perceived, are unattended with the emission of light, and therefore can never be visible to any other person than the subject of them, nor is it possible that they can ever make any other objects visible.

An attempt has been made by French medical jurists, to determine for how long a period a gun or a pistol lying near a dead body may have been discharged; but it is out of our power to lay down any precise rules on such a subject. All that we can say is, a quantity of sulphuret of potassium, mixed with charcoal, is left adhering about the barrel of the piece, when recently discharged; and this is indicated by its forming a strong alkaline solution, with water, evolving an odour of sulphuretted hydrogen, and giving a deep black precipitate with acetate of lead. After some hours or days, according to the exposure to air and moisture, the saline residue becomes converted to sulphate of potash, forming a neutral solution with water, and giving a white precipitate with nitrate of lead. If the piece have been discharged for a considerable time, oxide of iron with traces of sulphate may be found.

CHAPTER XLII.

ON BURNS AND SCALDS. BURNS FROM CORROSIVE LIQUIDS. SPONTANEOUS COMBUSTION.

A BURN is an injury produced by the application of a heated substance to the surface of the body; while a scald results from the application of a liquid at or near its boiling point, under the same circumstances. There seems to be no real distinction between a burn and a scald, for the injury resulting from boiling mercury or melted lead might take either appellation. Neither of these injuries appears to be considered as a wound in law, but in the statute of wounding, they are included among bodily injuries dangerous to life. (1 Vic. 85, sec. ii.)

Burns and scalds are *dangerous to life* in proportion to the extent of surface which they cover as well as the depth to which they extend. The extent of surface, involved in a superficial burn, is of greater moment than the entire destruction of a small part of the body through an intensely heated solid. When the burn is extensive, death may ensue either from the intensity of the pain produced, or from a sympathetic shock to the nervous system. Death takes place rapidly from burns, in children and nervous females: but in adults and old persons, there is a better chance of recovery. When death was due to intense pain, no post-mortem changes have been detected; but under other circumstances, it has been found on inspection, that there are patches of redness on the bronchial mucous membrane, as well as on that of the alimentary canal. The brain has been found gorged, and the ventricles containing an abundance of serosity. The serous liquids of the pericardium and pleura, have also been in larger quantity than natural. In short, besides congestion, there is generally abundant serous effusion in one of the three great cavities, especially in the cranium. (See cases by Mr. Long, Med. Gaz. xxv. 743; also, by Ericksen, xxxi. 551.)

If the person survive the first effects, he may die from inflammation, suppuration, gangrene, irritation, fever, or he may be worn out by exhaustion. In some instances, especially in children, stupor and insensibility have supervened, owing to a sympathy with the brain; and these symptoms have been followed by coma and death. If, under these circumstances, opium should have been given to the patient as a sedative, the stupor resulting from the burn, may be attributed to the effects of the drug; and should the person die, the practitioner may find himself involved in a charge of malapraxis. It may be alleged, as in the following case related by Mr. Abernethy, that the person was poisoned by opium.

A medical man was charged with the manslaughter of a child by giving to it an overdose of opium, when it was labouring under the effects of a severe scald. Mr. Abernethy stated in his evidence, which was given in favour of the practitioner, that he thought the exhibition of opium very proper:—that the quantity given, eight drops of tincture of opium immediately after the accident, and ten drops, two hours afterwards, was not an overdose for a child; (the age is not stated.) The circumstance of the child continuing to sleep until it died, after the exhibition of the opium, was no proof that it had been poisoned. This sleep was nothing more than the torpor into which it had been plunged by the accident. The surgeon was acquitted. Notwithstanding the favourable opinion expressed of this plan of treatment, it would be advisable to avoid the use of opium on these occasions, in respect to young children. We have elsewhere seen, how readily life is destroyed by the smallest doses of this drug; and there are no satisfactory means of distinguishing the comatose symptoms produced by a burn or scald, from those produced by an overdose of opium.

Did the burning take place before or after death? The production of vesication or of blisters containing serum, is commonly regarded as an essential character of a burn which has been produced during life. Vesication is especially seen in scalds, or where the skin has been burnt by flame, or by the ignition of the clothes. It is not so commonly observed in burns, produced by intensely heated solids. In vesication, the cuticle becomes raised from the the true skin beneath, and is converted into one or more blisters containing serum, while the skin around is of a deep red colour. It is very uncertain as to the time at which it appears; it may be produced in a few minutes, or sometimes not for several hours; thus, death may take place before vesication occurs, and the non-discovery of this condition, does not warrant the opinion, that the burn could not have taken place during life. If the cuticle be removed from a vesicated part in the living body, the skin beneath will become intensely reddened; but if the cuticle be stripped off in a dead subject, the skin will become hard, dry, and of a horny-yellow colour; it does not acquire the intense scarlet injection which is acquired by the living skin, under the same circumstances. When vesication is met with, is this certain evidence that the burn was vital,—that it took place during life? This question is of some importance in legal medicine. The following are, I believe, the facts, which have been hitherto ascertained. When boiling-water is poured upon the dead body ten minutes after death, the skin is simply ruffled and shrivelled; but the cuticle does not become raised into a blister. (Christison.) At a longer period than ten minutes, the same effects have been observed while the body retained its warmth. What the effect would be within a shorter period than ten minutes after death, it is not possible to say; nor is it likely that any experiments can be easily performed to determine this point. It is not probable, however, that vesication would follow after active life, indicated by the continuance of the functions of respiration and circulation, had ceased, except under circumstances to be presently stated. Dr. Christison, on one occasion, had an opportunity of trying the experiment on the same subject before and after death; it was in the case of a young man who had poisoned himself with opium. While he was lying in a hopeless state of coma, four hours before death, a hot iron was held on the outside of the hip-joint; and half an hour after death, a red-hot poker was applied to three places on the inside of the arm. Vesication followed the burns in both instances; but those caused during life contained serum, and those formed after death, air. In another experiment, a cauterizing iron produced no blisters on a leg, half an hour after amputation; but vesications, containing air, were formed, when the iron was applied in another case, ten minutes after amputation. On the whole, Dr. Christison thinks, that a vesication containing serum, indicates a vital, and one containing air, a post-mortem burn. I have performed many experiments on the bodies of infants eighteen and twenty-hours after death, both with boiling water and heated solids; but in no case have I observed any kind of vesication to follow at that period. The skin became shrivelled, and was partly destroyed by the heat, but there were no blisters produced.

It has been ascertained, that under certain states of the body, blisters containing serum may be caused in the dead subject, even twenty-four hours after death. M. Leuret observed, that this took place in an anasarcous subject, in the vicinity of which a heated brazier had been placed. The cuticle became hardened, then raised and blistered; and the blister contained an abundance of reddish-coloured serum. In repeating this experiment on other dead bodies not infiltrated, no vesications containing serum were observed to follow. (Ann. d'Hyg. 1835, ii. 387.)

In burns produced by red-hot solids, other effects besides vesication follow. The edge of the skin around the part burnt, is commonly of a dead white; and close to this, is a deep red line, gradually shaded off into the surrounding skin which is reddened. The diffused redness is removable by pressure, and disappears with life; the red line, however, is not removable by pressure, and is persistent after death. This line of redness is not always met with in severe burns; and where the individual survives one or two days, its production appears to depend on a power of reaction in the system. Thus, then, its absence furnishes no proof of the burn having a post-mortem origin; for it is not a necessary accompaniment of a vital burn. Dr. Christison has endeavoured to determine by experiments, whether this line of redness could be produced by applying a heated solid to the dead subject. He found that when the person had only been dead ten minutes, no such effect was produced. In repeating his experiments on dead subjects many hours after death, I have found that no line of redness ever presented itself, so that its discovery in a dead body burnt, would appear to indicate either that the burning took place during life, or within ten minutes after death, most probably the former. When, however, vesication and a line of redness are absent, we have no medical data on which to found an opinion as to whether the burn was caused before or after death.

In the case of a Mr. Westwood, who was murdered in June, 1839, the fact of certain burns found on the body, having been produced during life, was determined by Mr. J. G. French, from an observance of this sign. The deceased was found dead with his skull extensively fractured, his throat cut, and his body burnt in various places. Mr. French, who gave evidence on this occasion, remarked, that the burns were surrounded by a line of redness:—that they were probably produced about the same time as the other injuries, but certainly while there was some vital action in the system.

After murder has been perpetrated, it is not uncommon for a murderer to attempt to dispose of the body by burning it. This was remarked in the case of Mr. Paas, (the King v. Cook,) likewise in the case of the Queen v. Good, and still more recently, a case has occurred at Leeds, (Jan. 1843,) where a mutilated body was found floating in a river with marks of burning about it. In general, the body is not burnt until all signs of life have disappeared; we shall therefore meet, in such cases, with nothing but the charring of dead flesh, so that no difficulty can exist in forming an opinion. When the burning is partial, and has probably taken place from a wilful ignition of the clothes, at or about the time of death, some caution is required in expressing an opinion, since marks of vesication and a line of redness, are not always present in vital burns. It is by no means unusual, however, to find it stated in evidence, that blisters are a constant accompaniment of a burn in the living body.

In the case of the Queen v. Taylor, (York Lent Assizes, 1842,) the deceased was found dead with marks of strangulation on her neck:—her clothes were much burnt from her waist to the knees. She was lying across the hearth,—the body was much burnt as well as the upper and lower extremities of the neck; and in the opinion of the medical witness, the burn on the neck could not have been produced by the fire from the other part of the body. In cross examination he stated that the burns must have been done after death: they could not have taken place before, nor at the time of death, because there was no vesication, and he had never seen a burn on a living person which was not followed by blistering ! The prisoner was convicted, the counsel having failed to prove that death was caused as alleged by accidental burning.

The conclusions which it appears to me, we may draw from the foregoing statements, are : 1, that when we discover marks of vesication with serous effusion, or a line of redness or both, about a burnt part of the body, we are justified in saying, that the burn must have occurred during life ; 2, that when these appearances are not met with, it by no means follows, that the burn was not vital ; the affirmative evidence derived from such appearances being much stronger than the negative.

Whether a burn or a scald was or was not sufficient to account for death, must be determined by the extent, depth, and situation of the injury ; but even where the burn has clearly been caused during life, the body should be carefully examined for other marks of violence, as blows about the head ;—for wounds, marks of strangulation, and internally for hæmorrhage, disease, or poisoning. It must be remembered, that in burns which are rapidly fatal, the serous exhalation of cavities, has commonly a red colour, and the mucous membranes are also reddened. It is very rare that murder is perpetrated by burning ; the body is either burnt for the purpose of entirely destroying it, or the clothes are fired soon after a person has been killed, in order to conceal wounds or other violent means of death, and to make it appear that the deceased had been accidentally destroyed by fire.

Death by burning is either the result of accident or homicide, most commonly the former ; but medical evidence may give rise to a suspicion of murder under two circumstances : 1, when it is evident that several parts of the body have been fired at the same time, and the burns are such as not readily to be explained by the same accident, or by the accidental ignition of the clothes ; 2, when there are marks of homicidal violence on the body,—these marks, if we except fractures of the bones, may be easily effaced when the burn is extensive. Accidental deaths from this cause are very common among females and young children. In investigating a suspicious case, we must remember that the fact of the dead body not being found near a fire or any substance capable of causing ignition, does not justify an imputation of murder ; since the deceased, unless disabled by intoxication, infirmity, or disease, has the power of running away from the fire after an accident, and may be found dead at a distance without having been seen by any person.

Homicidal burning cannot be established by medical evidence, so much as by that which is presumptive or circumstantial ; but there are many medical questions which arise out of the circumstances under which a body is found burnt. Among reported cases, the two following may serve to illustrate the difficulties attending such investigations.

The first is that of a man of the name of Gilchrist, who was tried at Glasgow, for the murder of his wife. The prisoner and the deceased, according to the evidence, led a somewhat rambling dissipated life. On the evening of the alleged murder, the persons who lived on the floor above them, stated that they heard a noise like that of two persons struggling, and afterwards a moaning as of one choking or bleeding to death. A smell of fire now became perceptible in the house, which was soon filled with smoke. The witnesses being alarmed, went down to the prisoner's apartment and demanded admission. After some delay he admitted them, and in doing so, appeared to them to have come out of an inner room where he said he had been sleeping. On letting them in, he stumbled over the body of his wife who lay in the outer apartment quite dead, kneeling before a chair and very much burnt. The prisoner was accused of having murdered her and then burnt the body to conceal the manner of death. In his defence, he alleged that he had gone to bed tired, and that he knew nothing of what had happened to his wife until awoke by his neighbours. He presumed that her clothes had caught fire while she was intoxicated, and that she was thus accidentally burnt. The medical witnesses who examined the body reported that they found it so much burnt that they could give no opinion of the cause of death. The prisoner was condemned and executed, the general evidence being against him, although the precise manner of his wife's death, as Dr. Duncan observes, was not proved even presumptively.

In the second case which occurred at Leith, Dr. Duncan was the chief medical witness. The general evidence was similar to that adduced in the case of Gilchrist, but stronger against the prisoner. It appears that he and his wife lived on bad terms. On the night of the alleged murder, the prisoner was in bed, when his wife returned home with a lighted candle and some whiskey which she had procured at a neighbour's. Some time afterwards a struggling was heard in the apartment, and after this had subsided, a smell of fire was perceived to issue from it. The neighbours now endeavoured to obtain admission by knocking at the prisoner's door, but he either could not or would not hear them. At last a man forced his way in, by breaking the window of the outer room. On entering, he found the room full of smoke, and something burning in a corner, over which he instantly threw a pitcher of water:—this proved to be the body of the deceased. Several persons now entered the inner room, where they found the prisoner either asleep or feigning to be so. On being roused and told that his wife was dead, he expressed neither surprise nor sorrow; but coolly demanded by what authority his neighbours had broken into his house, and threatened to send for a constable to commit them. On an examination of the body, some parts were found completely carbonized by the action of the fire. On the face and extremities, however, the fire had not acted with such violence, and on these parts were found marks of vital reaction indicating that the burning had taken place during life. Some spots were merely red and inflamed, others scorched to a hard transparent crust but surrounded by a distinct redness: there were also many vesications filled with lymph. From these appearances, the witnesses gave it as their opinion that the deceased had been burnt to death. The jury in this case returned a verdict of not proven, considering probably that the deceased might have been accidentally burnt.

Dr. Duncan remarks, in regard to these two cases, that the action of the fire was extremely violent and destructive compared with the small quantity of combustible matter consumed. In both, the burns must have been produced by the ignition of the clothes alone, since there was no trace of burning of the house or furniture in either. In the second case, the deceased was found on the hearth with part of her clothes unburnt, and a chair from which she had fallen, quite entire. She was dead when the neighbours entered; and the body was discovered in the dark by the red light issuing from it.

An important question was raised on the second trial, in reference to the opinion of the deceased having been burnt to death, namely, whether the redness and blisters, remarked on the edges of the scorched parts, might not have arisen immediately after strangling or some other cause of death than burning, during the period when a lingering vitality remains in the body, and when undoubtedly certain phenomena of a vital nature, are frequently observed. The medical witnesses felt themselves unable to answer the question decisively, but they stated that they did not consider it at all probable that blisters could be produced on the body even immediately after death. (Med. Gaz. viii. 107.)

Supposing that a dead body is found burnt, and there is no other cause of death about it; it may be said that the burning was neither the result of accident nor of homicide, but that it was the effect of spontaneous or human combustion.

Human combustion.—There are two opinions concerning this so-called spontaneous destruction of the human body. On the one hand, some allege that the combustion may take place from internal causes,—in other words, that the process is literally *spontaneous:* on the other hand, it is contended that the contact of a substance in a state of ignition, is necessary for the production of the phenomenon,—so that according to this view, the human body merely becomes preternaturally combustible. The hypothesis of those who advocate *spontaneous* combustion, is, it appears to me perfectly untenable. So far as I have been enabled to examine this subject, there is not a single well-authenticated instance of such an event occurring:—in the cases reported which are worthy of any credit, a candle or some other ignited body has been at hand, and the accidental ignition of the clothes was highly probable if not absolutely certain. It is in vain that they who adopt this hypothesis, appeal to the electrical state of the atmosphere or of the individual, coupled with the impregnation of the system by the inflammable principles of alcohol, as conditions sufficiently explanatory of their views,—such explanations may be reserved until the occurrence of this spontaneous combustion from internal causes, is placed beyond all dispute. For a full description of the phenomena which are said to accompany this condition, see Casper's Wochenscrift, 1841, Nos. 8, 9, 10. We will now then consider, how far the views of those who allow that the body may acquire preternaturally combustible properties, are consistently borne out by facts. It is generally admitted that the human body is highly difficult of combustion; and therefore, if in any case, the degree to which it is consumed by fire is great in proportion to the small quantity of combustible matter destroyed about the person, it is not unreasonable to refer this to its possessing greater combustible properties. This is precisely the species of evidence which is furnished by the alleged cases of spontaneous combustion: the body has been found almost entirely consumed, and the clothes and other articles of furniture surrounding it, but little injured. A similar remark was made by Dr. Duncan, respecting the two cases just now related, in which the husbands were tried for the murder of their wives: in both it was the opinion of this physician that the bodies of the deceased were preternaturally combustible.

Without attempting to offer any explanation of the fact, there appears to be sufficient evidence on record, to bear out the view that the human body may, under certain circumstances, acquire increased combustible properties. At the same time, the medical jurist will perceive that this admission does not involve any difficulty in the judicial determination of a question of murder by burning, since it is contended that the combustion of the body cannot take place, except by contact with ignited substances. But whether the ignition of the clothes of a deceased person took place accidentally, or by the criminal act of an accused party, is a totally different question,—it is one in which a medical jurist is no more concerned than a non-professional witness,—this is, in fact, a point which can only be cleared up by general or circumstantial evidence.

If it be admitted that the body of one person will burn more rapidly and completely than that of another, this will be no ground of exculpation to a prisoner who is proved to have wilfully set fire to the clothes of that person. It may be urged in defence, that the prisoner might not have intended to destroy the deceased; and that, although he ignited the clothes, he did it without any malicious intention; and that death would not have been caused by his act, but for the preternatural combustibility of the body of the deceased. The intention which a person may have had in setting fire to the clothes of another, when he could not possibly know to what degree the burning would extend, is, of course, a question for a jury, to be decided from the circumstances. The relation of this subject of the alleged spontaneous combustion of the body to medical jurisprudence, appears therefore to have been much exaggerated. The only credible part of the doctrine, can never present any sort of difficulty to a medical jurist.

When several burns are found on a dead body, it may be a question, whether they were all produced at the same time. This is a point which can be determined only, by observing whether any of them present signs of gangrenous separation:—of suppuration,—granulation, or other changes that take place in a living body after accidents of this kind.

The witness may be asked, how long did the deceased survive the burn? A person may die in a few minutes or live some hours after receiving a most extensive burn; and yet there will be no changes in the part burnt, to indicate when death actually took place. There may have been no time for inflammation or its consequences to become established. Suppuration generally follows vesication; and in severe cases, it may occur by the second or third day; but often not until a later period. In regard to gangrene;—this takes place, when the vitality of a part burned, is destroyed. The time of its occurrence is uncertain, but it sometimes very speedily follows the accident.

Burns by corrosive liquids.—Among the cases in which medical evidence is sometimes required, is that of throwing sulphuric acid or other corrosive liquids on the person. This crime has been especially prevalent of late years, and until the recent alteration in the criminal law, there was no adequate punishment for it. On one occasion, the prisoner escaped the charge of felony, because it could not be considered in law, that sulphuric acid was capable of producing a wound—the man having been indicted for wounding. This case clearly showed a strong necessity for some legal definition of a wound, as well as the uncertainty of medical opinions; for while one surgeon considered that the injury produced was a wound, another thought that it was not. The judges decided that it was not a wound within the meaning of the statute. (The King v. Murrow, Liverpool Aut. Assizes, 1835.) The act 1 Vic. c. 85. s. v. while it punishes the offence, omits all reference to the definition of the word wound. The nature of the liquid thrown, is merely defined in general terms to be "any corrosive fluid or other destructive matter"—a point which will require t be settled by medical evidence.

In common language, and according to the statute, the injury thus produced is called a burn; but it is wholly different in its origin, as well as in its progress. I do not know that there has been a single instance, in which such an injury has directly destroyed life; but great deformity and actual blindness have resulted. A medical man is sometimes required to distinguish these injuries from burns and scalds—this may be easily done in the first instance, by the appearance o the part injured as well as by the description of the first symptoms The skin touched by a concentrated acid is destroyed and slough away, leaving a suppurating and granulating surface. The period o recovery will depend on the extent of the injury. Although a person may not die from the direct effects of the acid, yet in certain irritable constitutions, the inflammation which follows might prove fatal In young infants, or delicate nervous females, an extensive injury thu produced, may, however, readily destroy life. In the case of Mis Cashin, for whom an escharotic liniment was prescribed by a quack there was no doubt, that death was caused by the great local mischie produced by the application.

The nature of the acid may be determined by applying wetted linen t the part when the injury is recent, and examining the liquid thus absorbed. In general, however, evidence is readily obtained by examinin the spots or stains left on articles of clothing or furniture. Sulphuric aci is most commonly used; but a case has been elsewhere referred to wher nitric acid was employed, and led to the destruction of the sight of on eye. The caustic alkalies might also be used under these circumstances, and numerous other liquids on which the only medical opinio required would be, whether or not the liquid employed should be considered as corrosive or destructive matter. To constitute a felony, is necessary that the person should have sustained from the act throwing, some grievous bodily harm.

The mineral acids are sometimes used in other ways for the destruction of life.

In June, 1833, a man poured a quantity of strong nitric acid into the e of his wife, while she was lying asleep. She awoke suddenly with a viole pain in the ear, which continued for three days, whereby she became wea and exhausted. Soon afterwards there was copious hæmorrhage, and a portion of membrane escaped. She lost the use of her right arm, and became perfectly deaf. Suppuration took place from the ear, and blood escaped daily. She gradually sank and died, six weeks after the injury, the right half of the body having become convulsed before death. On inspection, a portion of the external ear was wanting, and the meatus was much wider than natural. The brain, near the petrous portion of the temporal bone, was softened and the bone itself carious. The injury had led to death indirectly by producing disease of the brain. (Med. Gaz. xvii. 897.)

SPONTANEOUS COMBUSTION.—Although we have seen that there is no proof of such a phenomenon as the spontaneous combustion of the living body, it must be admitted that by a reaction in the particles of organic or inorganic matter, combustion may take place independently of the approach or contact of an ignited substance. We are not now speaking of those effects that result from the admixture of bodies by chemists, with which every one, who has devoted but a slight attention to chemical manipulation, must be familiar,—but of certain other phenomena which, although assuredly dependent on, and explicable by the same laws, are far less commonly understood, and have only lately received any attention from the scientific inquirer. Let us suppose a case ;—In a floor-cloth manufactory,—in a granary, or storehouse, a fire may suddenly break out and spread through the whole building with destructive energy,—it is pronounced to be the act of an incendiary,—a person known to have harboured ill-feelings against the proprietors is seen coming from the spot just before the occurrence of the fire,—some careless expressions and a few apparently strong points of circumstantial evidence are adduced against him, he is tried, condemned and executed. It is here then, that a medical jurist is called upon to step forward and employ his science, not to shield a criminal, but to see that a human life is not sacrificed on a groundless charge. Should any individual be consulted on such occasions, it will undoubtedly be the medical practitioner, and the examination of this subject, therefore, must form a part of his duties: a slight reflection will teach him, that there is no member of society who ought to be so competent as himself to solve the questions which may arise. We have yet much to learn respecting the causes of this spontaneous combustion of bodies, for hitherto only a few isolated facts have been collected, some of which, however, are so striking and unprecedented, as to lead to the presumption that there exist many unsuspected substances which are capable of undergoing this singular change.

Towards the latter part of the last century, several fires occurred in the Russian navy, as well as in the warehouses on shore, which were at first attributed to incendiarism, but which were subsequently discovered to be owing to the spontaneous inflammation of masses of *hemp* and *flax* impregnated with oil. Experiments were made on the subject by the Imperial Academy of Sciences, and it was shown to the satisfaction of the Russian Admiralty, that such materials when heaped together and allowed to remain for some time with a full access of air, would spontaneously ignite. (Paris and Fonblanque, vol. i. p.

410.) The great fire at Plymouth dockyard in 1840, was supposed to have arisen from a similar cause, although there was a strong suspicion that it was the act of an incendiary.

Cotton impregnated with oil will also undergo spontaneous combustion. An accident of this kind occurred at New York in 1832, by which a ship and her cargo were nearly destroyed, owing to the spontaneous ignition of some bales of cotton on which oil had become spilled. But cotton of itself is capable of igniting when packed too early and before it is thoroughly dry. It was to this that the destruction of a ship in September 1834, was owing. The captain informed me that the cotton which he had on board, had been brought down to Bombay during the wet season,—that no attempt was made to dry it properly before shipping it, and that in this state, it was closely packed between decks, as well as in every spare part of the vessel. About a month after leaving the port, the crew were alarmed by an abundance of vapour issuing from the fore-hatchways. The vapour became more dense, and assumed the character of a thick smoke. Several bales of cotton were removed, but the danger became thereby increased, owing to the free current of air created, and in a very few hours the deck caught fire. The ship was then abandoned, and its total destruction speedily followed. Many similar accidents from cotton have occurred since that time.

It is well known that in the stacking of hay, if the grass is cut and stacked too early, combustion will almost inevitably follow,—this seems to be a phenomenon similar to that just described.

Another substance exposed to this singular condition is charcoal, especially in that form of it called *Lamp-black*. A few years since, a ship laden with some lamp-black, in casks, sailed from Portsmouth. In about six weeks afterwards a strong smell of burning was perceived to issue from the fore-hold, accompanied by smoke. On examination, it was found that a large cask of lamp-black was giving out volumes of smoke, although not actually in flames. It was with some difficulty, owing to the intense heat of the cask, that it could be got on deck and thrown overboard; in this case, it was presumed that the admission of air to the interior of the cask would have caused its instant ignition. In consequence of this discovery the whole of the lamp-black on board, to the number of sixty-one casks, was thrown into the sea, and several of them were observed to be in a state of smothered combustion, the casks were surrounded by a number of barrels of tar, and jars of oil, but it did not transpire whether any of these inflammable substances had become mixed with the contents. No light had been allowed in the hold since leaving England,—it was therefore a clear instance of spontaneous combustion.

The cause of this phenomenon in charcoal is not well understood. The following facts we derive from the experiments of M. Aubert. When recently-made charcoal is reduced to a very fine state of division, it rapidly absorbs air and aqueous vapour, especially the former. The air undergoes no change up to the moment at which combustion ensues, but a considerable quantity of heat is extricated, which this experimentalist found at one time to be equal to 350° F. The greatest degree of heat was observed to be in the centre or about five or six inches below the surface, and it appears that here ignition first commences, if there is a tolerably free access of air. M. Aubert found that the most inflammable charcoal required to be in masses of at least sixty pounds, for inflammation to take place spontaneously, and the less inflammable the charcoal, the larger the quantity required to be collected in a heap. In all these cases the charcoal was pulverized, and the shorter the time suffered to elapse between its manufacture and its pulverization, the more certainly and rapidly did ignition take place. Air is not only necessary for the spontaneous inflammation of this substance, but there must be a free access of it to the surface of the mass.

For a knowledge of another body, largely existing in certain manufactures, possessing the property of spontaneously igniting, we are indebted to Mr. Scanlan. (Records of General Science, August 1835.) In March 1835, a fire broke out in a turpentine distillery, at Dublin. The fire was confined to what is termed by turpentine-distillers *Chip-cake,* and it could only be attributed, under the circumstances, to the act of an incendiary or to the spontaneous ignition of this substance. The raw American turpentine, as it is imported, contains many impurities in the form of chips of wood, leaves, and leaf-stalks. These impurities are commonly separated by heating the turpentine to about 180° and straining it,—the mass thus separated (which is subsequently exposed to a temperature of 212°) is called chip-cake: when thus obtained it has not been known to undergo spontaneous combustion. On the occasion above-mentioned, a new plan had been adopted by the manufacturer. The raw turpentine with its impurities was exposed at once to a temperature of about 250°, and the boiling rosin was then strained from the chips. The chip-cake from this process was laid in a heap outside the still-house, about three o'clock in the afternoon, and at midnight was observed to be in flames. Mr. Scanlan found, in making his observations upon a portion of chip-cake thus prepared, that the temperature gradually increased in the centre of the heap, although on the exterior, it was cold and brittle: in four hours, a thermometer rose to 400°, and a large quantity of vapour, accompanied by a strong odour of pitch and rosin, was extricated. The exposure of the mass experimented on, took place at one o'clock in the afternoon, and though it rained hard during the night, at half-past seven the following morning it burst into a flame. Three experiments were made and were attended by similar results,—in the third, the porous heap appeared to become red-hot in the centre, so that the adhering rosin melted and dropped from beneath.

In the same paper, this gentleman mentions that a friend of his, who had placed a quantity of *Red fire* in a store-room, was surprised by its spontaneously igniting and becoming entirely consumed the following day, while he was in an adjoining apartment. This powder is much used in theatres for the production of artificial light,—it is a mixture of nitrate of strontian, sulphur, sulphuret of antimony, chlorate of potash and charcoal: this I believe is the only instance on record of its spontaneous combustion. It has been a question, whether the lucifer matches which are now so extensively sold, are not subject to spontaneous combustion. One fact is certain, that many kinds of these matches will ignite with the slightest friction, and thereby occasion alarming acidents. (See Ann. d'Hyg. 1841, 309.) Other facts might be quoted relative to the spontaneous ignition of substances, which are not commonly supposed to possess such a property; but I think enough has been said to induce a medical jurist to give his attention to this curious phenomenon, and on a charge of incendiarism, founded on mere presumption, to act as the defender of an accused party,—should the facts of the case warrant the belief that the fire had originated from any of these secret operations of nature.

INFANTICIDE.

CHAPTER XLIII.

GENERAL REMARKS. TO DETERMINE THE AGE OR DEGREE OF MATURITY OF THE CHILD.

By infanticide we are to understand in medical jurisprudence, the murder of a new-born child. The English law, however, does not regard child-murder as a specific crime; it is treated like any other case of murder, and is tried by those rules of evidence which are admitted in cases of felonious homicide. In saying that infanticide is the term applied to the murder of a new-born child, it is not thereby implied that the wilful killing should take place within any particular period after birth. Provided the child be actually born and its body entirely in the world, it matters not whether it has been destroyed within a few minutes or not until several days after its birth. In the greater number of cases of infanticide, however, we find that the murder is commonly perpetrated within a few hours after the birth of the child.

Although the law of England treats a case of infanticide as one of ordinary murder, yet it is to be observed that there is a particular difference in the medical evidence required to establish the murder of a new-born child. It is well known that in the course of nature, many children come into the world dead, and that others die from various causes soon after birth. In the latter, the signs of their having lived are frequently indistinct. Hence, to provide against the danger of erroneous accusations, the law humanely presumes that every new-born child has been born dead, until the contrary appear from medical or other evidence. The onus of proof is thereby thrown on the prosecution; and no evidence imputing murder can be received unless it be made certain by medical or other facts, that the child survived its birth and was actually living when the violence was offered to it. Hence there is a most difficult duty cast upon a medical witness.

In cases of child-murder, medical evidence is commonly founded upon an examination of the body of the child; but it must be borne in mind, that a woman may be found guilty of the crime, although the body of the child be never discovered:—it may have been destroyed by burning or otherwise disposed of, and a medical witness may have only a few calcined bones to examine. In these cases of the non-production of the body, good legal evidence of the murder would, however, be demanded; and this evidence should be such, as would satisfactorily establish a matter of fact before a jury. The production of the body of the child is therefore no more necessary to conviction, than in any other case of murder. A woman has been tried within the last few years for the murder of her child, the body of which was never discovered.

In most instances, however, the body of the child is found,—an inquest is held, and medical evidence is demanded. In giving evidence at a coroner's inquest on a case of infanticide, as much care should be taken by a practitioner, as if he were delivering it before a judge at the assizes. Some witnesses are disposed to treat an inquest with indifference; and to be careless in their evidence, thinking probably that should the case come to trial, they could prepare themselves and amend any statements which subsequent reflection might show them to have been hastily made before a coroner. But it ought to be known that the depositions taken by this officer, may at the trial, be placed in the hands of the judge and the prisoner's counsel; and should a witness deviate in his evidence at the assizes, from that which he gave at the inquest,—or should he attempt to amend or explain any of the statements then made, so that they might, by the ingenuity of a barrister, be represented as having a new bearing on the prisoner's case, he would expose himself not merely to a severe cross-examination, but probably to the censure of the court. If medical men were to reflect that in delivering their opinions before a coroner and jury, they are, in many instances, virtually delivering them before a superior court, it is certain that many unfortunate exposures would be easily avoided.

Age or maturity of the child.—One of the first questions which a witness has to consider in a case of alleged child-murder, is that which relates to the age or probable degree of maturity which the deceased child may have attained in utero. The reason for making this inquiry, is that the chances of natural death, in all new-born children, are great in proportion to their immaturity; and that supposing them to have survived birth, the signs of their having respired are commonly very obscure. It is found that the greater number of children which are the subjects of these investigations, have reached the eighth or ninth month of gestation; yet charges of murder might be extended to the wilful destruction of children at the seventh month or under, provided the evidence of life after birth were clear and satisfactory. The English law does not adopt the principle which exists in the codes of some Continental states, namely, that a child, in order to become the subject of a charge of murder, should be born *viable*, i. e. with a capacity to live. It is observed by Mr. Chitty, although no authority is quoted for the statement, that "the object of the law is to prevent injuries to infants having capacity to maintain a separate existence;" and he further suggests that such a capacity should be proved in order to complete the offence of infanticide. (Med. Jur. i. 411.) This argument, carried to its full extent, would render it justifiable to put to death all persons afflicted with any mortal disease. I have been unable to find, in the numerous reported trials for infanticide, any ground for this extraordinary doctrine. The capacity of a child continuing to live has never been put as a medical question in a case of alleged murder, and it is pretty certain, that if a want of capacity to live were actually proved, this would not render the party destroying it, irresponsible for the offence. Children may be born alive at the sixth or seventh month, but because they are much less likely to survive than those born at the eighth or ninth month, this is not a sufficient ground of exculpation to any person who wilfully destroys them. The real question, as we shall presently see, does not refer to the period of gestation at which a child may be born, but to the fact of its being living and entirely born when the murderous violence is offered to it.

Although the principle above referred to, is not recognized in English jurisprudence, yet in the following case, which occurred in October 1836, a coroner refused to hold an inquest on the body of a child, because it had not reached an age at which children are commonly born alive.

The child was found dead and exposed, but before proceeding to hold an inquest, the coroner required an opinion from the medical witness respecting its age. The opinion was, that it had not passed beyond the fifth month of utero-gestation. The coroner then declined to interfere; because it was laid down by a high law-authority, that an inquest on the body was unnecessary where the child had not reached the seventh month.

In this case, there was probably no harm done; but when we consider: 1, the great difficulty of determining the exact age of a child from the characters found on its body: and 2, that many children born under the seventh month, have not only been born alive, but have lived to adult age, the acting on a principle of this kind would be likely to give rise to dangerous abuses. It is impossible to admit that children are to be destroyed with impunity because they happen to be born under the seventh month, or that every child at this period should be assumed to have been born dead, and any inquiry into the cause of death dispensed with, unless it can be medically established that it had passed the seventh month of gestation.

Dr. Beck says, "If it can be proved that the child, which is the subject of investigation, has not attained this age, (the seventh month,) no charge of infanticide *can* or *ought* to be entertained." (Med. Jur. 245.) Are we to understand by this that children proved to have been born living before the seventh month, may be wilfully destroyed, and the law take no cognizance of the matter?—if this be not the meaning, the statement amounts to nothing, because whether the child have reached the seventh, eighth, or ninth month, life and live birth must still be proved, before the question of murder can be entertained.

I have known an instance of a child born between the sixth and seventh month, living a fortnight, and many similar cases are recorded. On the doctrine above laid down, the deliberate destruction of such children, although actually living, ought not to be considered or treated as murder!

The following are the characters, whereby we may judge of the age of a child from the sixth to the ninth month of gestation.

Between the *sixth* and *seventh* month. The child measures from the vertex to the sole of the foot, from eleven to twelve inches, and weighs about two pounds. The head is large in proportion to the trunk,—the eyelids are adherent and the pupils are closed by the membranæ pupillares. The skin is of a reddish colour, and the nails are slightly formed;—the hair loses the silvery lustre which it previously possessed, and becomes darker. Ossification proceeds rapidly in the sternum, and in the bones of the tarsus. The brain continues smooth on its surface:—there is no appearance of convolutions. In the male the testes will be found in the abdominal cavity, lying upon the psoæ muscles immediately below the kidneys.

Between the *seventh* and the *eighth* month. The child now measures between thirteen and fourteen inches in length, and weighs from three to four pounds. The skin is thick, of a more decidedly fibrous structure, and covered with a white unctuous matter, which now for the first time appears. Fat is deposited in the cellular tissue, whereby the body becomes round and plump:—the skin previously to this, is always more or less shrivelled. The nails, which are somewhat firm, do not quite reach to the extremities of the fingers. The hair becomes long, thick and coloured. Ossification advances throughout the skeleton. Valvulæ conniventes appear in the small intestines, and the meconium is found occupying the cæcum and colon. The testicles in the male are considered about this period to commence their descent, or rather, the child's head being downwards, their ascent towards the scrotum. The time at which these organs change their situation, is probably subject to variation. According to J. Hunter, the testes are situated in the abdomen at the seventh, and in the scrotum at the ninth month. Burns believes that at the eighth month they will commonly be found in the inguinal canals.

Between the *eighth* and *ninth* month, the child is from fifteen to sixteen inches in length, and weighs from four to five pounds. The eyelids are no longer adherent, and the membranæ pupillares will have disappeared. The quantity of fat deposited beneath the skin is increased, and the hair and nails are well developed. The surface of the brain is grooved or fissured, but presents no regular convolutions; and the cineritious matter is not yet apparent. The meconium occupies almost entirely the large intestines, and the gall-bladder contains some traces of a liquid resembling bile. The testicles in the male, may be found occupying some part of the inguinal canal, or they may be in the scrotum. The left testicle is sometimes in the scrotum, while the right is situated about the external ring.

At the *ninth* month.—The average length of the body is about eighteen inches, and its weight about six pounds, or between that and seven pounds: the male child is generally rather longer, and weighs rather more than the female. Extraordinary deviations in length and weight, are occasionally met with. Mr. Owens, of Ludlow, has reported a case in which the child at delivery measured twenty-four inches, and weighed seventeen pounds twelve ounces. (Lancet, Dec. 1838.) In a case which I had to examine in June 1842, the child, a male, measured twenty-two inches, and weighed twelve pounds and a half. For an excellent essay on this subject, by Dr. Ellsässer, see Henke's Zeitschrift, 1841. 2,235. At this period, the head of the child is large, and forms nearly one-fourth of the whole length of the body. The cellular tissue is filled with fat, so as to give considerable plumpness to the whole form, while the limbs are firm, hard and rounded. The hair is thick, long and somewhat abundant. The nails are fully developed and reach to the ends of the fingers;—an appearance, however, which may be sometimes simulated in a premature child, by the shrinking of the skin after death. The testicles in the male, are generally within the scrotum. Ossification will be found to have advanced considerably throughout the skeleton. The surface of the brain presents convolutions, and the cineritious matter begins to show itself. The internal organs, principally those of the chest, undergo very marked changes if the act of respiration have been performed by the child before, during or after its birth.

The relative position of the point at which the umbilical cord is inserted into the abdomen, has been considered by some medical jurists to furnish evidence of the degree of maturity. Chaussier thought that in the mature child, at the ninth month, the point of insertion of the cord exactly corresponded to the centre of the length of its body. Later observations, however, have shown that this is not quite correct. Out of five hundred children examined by M. Moreau, at the Maternité, in Paris, the umbilical aperture corresponded to the centre of the body, in four only. In the majority of these cases, the point of insertion was eight or nine lines below the centre; among many cases of mature children, which I have had an opportunity of examining, the umbilical aperture has generally been from a quarter to half an inch below the centre of the body. (Guy's Hospital Rep. April 1842.) M. Moreau found that in some children, born about the sixth and eighth month, the cord was inserted at the middle point of the length. (Lanc. Franç. 1837.) On the whole, it will be perceived that not much value can be attached to the situation of the umbilical opening, as a sign of maturity or immaturity.

The characters which have been here given as belonging to a child at the different stages of gestation, must be regarded as an average statement. They are, it is well known, open to numerous exceptions; for some children at the ninth month are but little more developed, than others at the seventh. Twins are generally less developed than single children, and the average weight of a twin child is not more than five pounds, and very often under this. The safest rule to follow in endeavouring to determine the age of a child, is to rely upon a majority of the characters which it presents. That child only can be regarded as mature, which presents the greater number of those characters already described, and which are met with in children at or about the ninth month of gestation.

Let us suppose that the age of the child has been determined :—whether it be under or over the seventh month, the same rules for a further investigation, will be demanded. Should the child be under the seventh month, the medical presumption will be that it was born dead; but if it has arrived at its full period, then the presumption is, that it was born alive.

CHAPTER XLIV.

ON THE PROOFS OF A CHILD HAVING LIVED AT ITS BIRTH.

The question whether a child was or was not born alive is of the greatest importance in a case of alleged child-murder; and it is unfortunately one which in respect to the proofs upon which medical evidence is commonly founded, has given rise to considerable controversy. When it is stated that in most cases of alleged infanticide which end in acquittals in spite of the strongest moral presumptions of guilt, the proof fails on this point only, it must be obvious, that this question specially claims the attention of a medical jurist. The medical evidence of a child having been alive, when violence was offered to it at its birth or afterwards, may be divided into two parts; 1, that which is obtainable before the act of respiration is performed; and 2, that which is obtainable afterwards. At present it will be proper to confine our attention to the question whether the child was alive when it was maltreated,—the fact of its having been *born* alive, will be a matter for future consideration. These two questions have been frequently mixed together, thus rendering the subject confused; but it must be so obvious as scarcely to require stating, that violence of a murderous kind may be offered to a living child before it is entirely born; and that owing to this violence, it may come into the world dead.

Evidence before respiration.—It was formerly supposed that if the lungs contained no air, the child could not have respired, and that it must have been born dead. But neither of these views is correct :—children have been known to respire faintly, and continue in existence many hours without visibly distending the cells of the lungs with air,—the absence of air from the lungs, therefore, furnishes no proof either that respiration has not been performed, or that the child has not lived. (G. H. Rep. April, 1842.) That our law-authorities will admit evidence of life in a child before the establishment of respiration, is clear from the decision of Judge Park, in the case of R. v. Brain, in which he said, that a child might be born alive, and not breathe for some time after its birth, (Archbold, Crim. Plead. 367,) as also from the charge of Mr. Justice Coltman in the case of R. v. Sellis, (Norf. Spr. Circ. 1837.) In this instance it was alleged, that the prisoner had murdered her child by cutting off its head. The judge told the jury that if the child were alive at the time of the act, it was not necessary, in order to constitute murder, that it should have breathed. In fact, it would appear that respiration is regarded as only one proof of life; and the law will, therefore, receive any other kind of evidence which may satisfactorily show that the child had lived, and make up for the proof commonly derived from the state of the lungs.

It will be first incumbent on a medical practitioner to prove, that the child under examination has recently died, or in other words, that there are good grounds for believing it to have been recently living. Hence if the body be highly putrefied, either from the child having died in the uterus some time before birth, or from its having been born and its body not discovered until putrefaction had far advanced, both internally and externally,—the case is utterly hopeless. The medical witness must abandon it, because the body can furnish no evidence whatever of life after birth. The examination of the internal organs would throw no light on the case: for we are here assuming that the lungs preserve their fœtal condition.

The phenomena of putrefaction in air require no notice in this place; but the changes which ensue, when the child dies and is retained within the uterus, may be briefly adverted to, because they may sometimes form a subject for judicial inquiry. According to Devergie, when the child dies in utero, putrefaction takes place as rapidly as in the open air; but this is extremely doubtful. (Méd. Lég. i. 526.) In an advanced state of uterine putrefaction, the body of the child is so flaccid, that it becomes almost flattened by the mere gravitation of its parts when placed on a table. The skin is of a reddish brown colour, not green as in a putrefied body, exposed to air. The epidermis of the feet and hands is white, and sometimes raised in blisters,—the cellular membrane is filled with a reddish-coloured serum, the bones are moveable and readily detached from the soft parts. In the opinion of Devergie, the principal difference between uterine and atmospheric putrefaction in respect to the body of a new-born child, is seen in the colour assumed by the skin:—but it must be remembered, that should the child remain exposed to air after its expulsion, the skin may acquire the colour seen in cases of atmospheric putrefaction. The changes which have just been described are such as we may expect to find, when the child has been retained in utero, eight or ten days after its death. When it remains for some weeks before it is expelled, the body has been occasionally found saponified and incrusted with phosphate of lime. If in any case we are able to state, that the body of a child has undergone uterine and not atmospheric putrefaction, it is clear that it could not have come into the world alive. Under ordinary putrefaction in air, the child may have been really brought into the world living, and the process may have destroyed every proof of that fact.

Let us suppose that the child died in utero from forty-eight to twenty-four hours before it was born :— if it be soon afterwards examined, there will be no marks of putrefaction about it, and the appearances will closely resemble those met with in the body of a child which has been born alive and died without respiring :—or of one which may not have been born alive, but have died in the act of birth. It will be impossible to say in such a case, whether the child came into the world living or dead.

It has been proposed to seek for evidence of life under these circumstances, by observing the characters presented by marks of violence on the body. In general, when children are murdered, the amount of violence inflicted, is considerably greater than that which is required to destroy them, whereby satisfactory proofs of the crime are occasionally obtained. On the other hand, the body of a still-born child, dead from natural causes, is often covered with lividities and ecchymoses ;—the fœtal blood does not coagulate with the same firmness as in the adult : hence the evidence derivable from the extent, situation and characters of marks of violence, is generally of too vague and uncertain a kind, to allow of the expression of a medical opinion, that the child was certainly living when the violence was offered to it. The characters which have been already described as peculiar to wounds and contusions inflicted during life, (antè, p. 286,) may be met with in a child whether it have breathed or died without respiring. So again, these characters are open to the exceptions there pointed out ; for they will be equally present, supposing the wounds to have been inflicted immediately after the cessation of respiration or circulation in the child, or after the cessation of the circulation only,—supposing the act of respiration not to have been performed.

Marks of violence on the body of a child which had died in utero twenty-four or forty-eight hours before it was born, would not present the characters of injuries inflicted on the living. There would be no ecchymosis and no effused coagula of blood. These marks, when they exist, although they may establish that the child was either living or but recently dead at the time they were received, can never show that the child was born alive. Injuries met with on the bodies of children alleged to have been born dead, ought however to be of such a nature as to be readily explicable on the supposition of their having arisen from accident. If they be such as to evince a wilful design to injure, from their nature, extent, or situation, it is a fair ground for a jury,—not for a medical witness, to inquire why these extensive wounds, or other marks of violence, were inflicted on a child, if, as it is alleged, it were really born dead. It must be confessed that in such a case there would be a strong moral presumption of murder, although medical proof of life, or of actually live birth, might totally fail.

As a summary of these remarks, it may be observed, that although physiologically a child may live for a certain period after its birth without respiring,—and legally its destruction during this period would amount to murder, yet there are at present no satisfactory medical data to enable a witness to express a positive opinion on this point. If other evidence were adduced of a child under these circumstances having lived and been destroyed; as where, for example, a woman causes herself to be delivered in a water bath, or an accomplice covers the mouth of an infant immediately after it is born, a medical witness would be justified in asserting, that the absence of the signs of respiration in the lungs, was no proof that the child had been born dead. Indeed it is apparent, that the process could not be established from the criminal means actually employed to prevent it. Whether a jury would convict upon such evidence is doubtful: but this is of no importance to the witness:—his statements ought always to be made according to correct and well-ascertained principles, not for the purpose of procuring either the conviction or acquittal of parties accused of offences against the laws. In general, those cases in which questions relative to life before respiration, might arise, are stopped in the coroner's court,—the general practice being, where the signs of respiration are absent or imperfect, to pronounce that the child was born dead. If the lungs sank in water, the presence of marks of violence on the body would be considered as furnishing no evidence:—for the sinking of the lungs would be taken as positive evidence of still-birth, an inference upon which some remarks will be made in speaking of the hydrostatic test. In the mean time the following case, which was the subject of a criminal charge at Havre in 1828, is in this respect interesting.

A woman was delivered of twins. So soon as the first child was born, but not before it had breathed, she killed it by fracturing its skull with a wooden shoe. In a few moments afterwards, the second child was born, but scarcely had its head presented, when she seized it, and fractured it in the same manner. This double crime was soon discovered. On an examination of the bodies of both children, the same degree of violence was found, presenting in each case precisely similar characters. There could be no doubt, from the appearance of the injuries, that they must have been inflicted on both children at a time when the circulation was going on. In one child, however, it was proved that respiration had taken place, in the other that it had not. In the latter case many practitioners would at once have affirmed, that the child had not lived, because it had not respired, and would have proceeded to draw the inference that this could not have been a case of infanticide. Dr. Bellot, however, declared, that, although the child had not breathed, he had no doubt that it had been born alive, and that it would have lived to respire, but for the violence inflicted. This opinion was chiefly founded upon the similarity in the characters presented by the marks of violence in the two cases. (Annales d'Hygiène, 1832, ii. 199.)

EVIDENCE AFTER RESPIRATION.—There is no doubt that the proof of the act of respiration furnishes the best and strongest evidence of a child having lived at or about the time it was born. It does not, however, show that a child has been *born alive.* The physical changes in the organs of a child, which result from the establishment of this process, take place in the lungs immediately, but in the heart and its appendages more slowly. It is, therefore, chiefly to the lungs that a medical witness looks for the proofs of respiration having taken place. Sometimes, however, these organs are found in their fœtal condition, or nearly so:—for although a child may have survived its birth for many hours, there may be no evidence of this from the state of the lungs. To such cases the remarks now about to be made cannot, of course, apply:—the proofs of life must be sought for elsewhere, and if none can be found, the case is beyond the reach of medical evidence. But it is obvious that the occasional occurrence of cases of this description can present no objection to our constantly seeking for proofs of life in the lungs, any more than the fact of poison not being always discovered in a poisoned subject, is a bar to our seeking for the proofs of poison in every unknown case which presents itself. It is the more necessary to insist upon this point, because some have held, that as we cannot always derive proofs of life from an examination of the lungs of new-born children, we should abandon all evidence of this description, and leave the case in its original obscurity. The very object of medical jurisprudence is, to endeavour to remove these difficulties, and to show in every department of the science, the degree to which we may safely trust the medical proofs of crime, however inconsistent or contradictory they may at first sight appear.

Before proceeding to inspect the body, notes should be made of every appearance indicative of violence, either certain or suspected, in order that these may serve for after-consideration on the cause of death. It must be presumed also that the weight and length of the body have been determined for reasons already stated. We should also always notice, whether the umbilical cord be cut or lacerated, and at what distance from the abdomen of the child. These points, unless attended to before making an incision into the skin, will be lost as evidence.

Some have pretended that the fact of respiration having been performed would be indicated by the external configuration of the chest. Thus it is said, before respiration the chest is flattened, while after that process it is arched anteriorly. The diameters of the cavity have also been measured, and certain comparisons instituted, (Daniel,) but these experiments have been attended by no practical result, and have long been abandoned by medical jurists. Admitting that such a visi; ble change of form is occasionally produced by respiration, it is obvious that in these cases, experiments on the lungs may be readily made - and on the results of these, and not upon minute changes in the capacity of the chest, would a medical opinion be based.

The cavity of the chest may be conveniently laid open by carrying incisions from below the clavicles downwards on each side from about half the length of the ribs backwards. The diaphragm may be separated from the cartilages without opening the abdomen; the ribs sawn or cut through, and the flap formed by the anterior parietes of the chest, turned upwards. If the child have *not respired*, the following appearances will be seen. The thymus gland, as large as the heart, occupies the upper and middle portion of the cavity;—the heart in its pericardium is situated in the lower and middle portion, and is rather inclined to the left side. The lungs are placed quite in the back part of the chest, so as often to give the impression that they are wanting. In some instances, they project slightly forwards by their anterior margins, but in no instance, unless congested, infiltrated or otherwise diseased, do they cover and conceal the pericardium. The thymus gland is sometimes of a pale fawn—at others of a deep livid colour: but there is no perceptible difference in this organ in new-born children, before or after the performance of respiration. On the other hand, when the child has *fully respired*, the appearances will be as follows. The most striking differences will be in the colour and prominence of the lungs. They are of a light red hue, project forwards—appear to fill the cavity of the chest, and cover and in great part conceal by their anterior margins, the bag of the pericardium. We may meet with every variety in the appearances between these two extremes; for the process of respiration often requires a considerable time in order that it should be fully established, especially in those children which are of weakly constitution or prematurely born. Hence the lungs will be found to occupy their respective cavities to a greater or less extent, and to cover the pericardium more or less, not according to the length of time which a child has lived, but according to the perfection with which the process of respiration has been performed. It will be seen hereafter, that although as a general rule the lungs become more perfectly filled with air in proportion to the time which a child survives its birth, yet this is open to numerous exceptions. It will next be necessary to give particular attention to certain other physical characters presented by the lungs.

1. Colour.—The colour of the lungs before respiration is of a blueish red, or deep violet, but it is subject to slight variation. Some medical jurists have compared it to that of the adult liver. It is important to remark, that a very short exposure to air will materially alter the colour, so that it should be observed and recorded immediately on opening the chest. After respiration, the lungs acquire a pinkish red hue, which is light in proportion to the degree in which the process has been performed. If imperfectly established, the lungs will be mottled, generally about the anterior surfaces and margins, the patches of light red being intermixed with the livid fœtal hue, and being slightly raised, as if by distension, above the general surface of the organs. The light red tint changes, after a short exposure to air, to a bright scarlet. This change in the colour of the lungs is not a necessary, nor is it an invariable consequence of a child having lived after its birth. I have known a child to live twenty-four hours respiring feebly, and on examining the body the colour of the lungs was identical with that of the organs in the fœtal state. The change of colour

is then a usual, but by no means a necessary consequence of the enjoyment of life:—so that its absence does not furnish positive evidence of still birth. Again, the circumstance of the lungs having a pinkish red colour is not an infallible criterion of the child having lived and breathed, for the artificial introduction of air by a tracheal tube, or otherwise, in the attempt to resuscitate a still-born child, is attended with the same physical change. At least, in the course of numerous experiments, purposely made, I have found no appreciable difference. Bernt says, that artificial inflation cannot produce a scarlet red tint in the organs, and therefore that this is a criterion of respiration. (Ed. Med. and Surg. Jur. xxvi. 367.) I have not only observed this tint to be absent in respiration, but have actually produced it by artificial inflation in a dead child.

2. Volume.—The difference in the relative situation of the lungs before and after respiration, has been already described. This difference depends entirely upon the increased volume or dilatation of the organs arising from the introduction of air. Before respiration, the lungs are in general scarcely visible, unless forcibly drawn forwards in the chest. When respiration has been perfectly accomplished, the volume is so much increased, that the bag of the pericardium is almost concealed by them. Respiration must, however, have been very perfectly performed in order that this condition should exist to the full extent described; but I have known the lungs to acquire a considerable volume in a healthy and vigorous child from only two or three respirations. The child was destroyed by craniotomy, and died before it was entirely delivered. In other instances, a child may live for one or two days, and the volume of the organs be but little altered. Schmitt has remarked, that the lungs have sometimes a considerable volume before respiration—I have met with this in one instance; but this condition will probably be in general found to depend on disease. It must not be forgotten that this physical change in the lungs depends on the introduction of air:—hence the effect is the same, whether the air be derived from respiration,—from artificial inflation, or generated by putrefaction. Other circumstances must therefore be considered, before we draw any inference from the increased volume of the lungs.

3. Consistency.—The lungs, before respiration, feel like the liver, or any of the other soft organs of the body. They are firm under the finger, but their substance may be lacerated by violent compression. After respiration has been fully performed, there is a distinct sensation of what is termed crepitus on compressing them, i. e. air is felt within them. This condition of the organs must, of course, depend on the degree to which respiration has gone on. The lungs of children that have lived for a considerable time after birth, will sometimes give no feeling of crepitation under the finger. Generally speaking, lungs of this kind present the other fœtal characters:—thus they are small and of a livid colour. There are, however, cases in which the organs may have the pinkish red colour of respiration, and be actually much dilated in appearance, yet no feeling of crepitus will be percepti-

ble on pressure. This character, therefore, is by no means a necessary accompaniment of the other two. Crepitation furnishes presumptive evidence of respiration; but it may be equally met with in lungs that are putrefied, or which have received air by artificial inflation.

The characters here described are seldom found in the lungs of children that have been born prematurely, although they may have lived for some time after birth. They depend on respiration; and in the cases referred to, this process is only very slowly established.

4. ABSOLUTE WEIGHT. *The static test.*—It is generally admitted by medical jurists, that the weight of the lungs before respiration is less than that which they have after the establishment of the process. From this an inference has been drawn, that the absolute weight of the lungs in an unknown case, compared with certain averages, will enable us to ascertain whether respiration has or has not been performed. In order to determine the weight of the lungs, these organs should be carefully separated by dissection from the heart and thymus gland, and removed with the trachea and bronchi attached. Previously to their removal, ligatures should be placed on the pulmonary vessels, so that no blood which the lungs contain, may escape. They should now be weighed, and the weight accurately noted in grains. In taking this weight, it does not appear necessary to make any distinction founded on the sex of the child, or the difference of weight in the two lungs; the only exception would be, perhaps, in relation to twin children imperfectly developed. The average weight before respiration, derived from nine cases reported in the table, is 649 grains. (See pòst.) It is of importance, in making an estimate of this kind, to be certain that the child is at or near maturity; and it would be better, in all reports of cases relating to infanticide, if, instead of the bare assertion that the child was mature, the reporter would describe its general characters, so that every one might have the opportunity of forming a judgment on the subject. Owing to a neglect of this rule, it is pretty certain that comparisons have been made of the absolute weight of the lungs in different children, which a full statement of the facts would not have justified. The above average may require further correction, but the cases on which it is founded have been carefully observed.

The average weight of the lungs after respiration, derived from the three cases in the table, is 927 grains; (see pòst;) but in making an estimate of this kind, much will depend upon the degree to which respiration has been carried. In three cases, where the children lived half an hour, six hours, and twenty-four hours respectively, the process had been so imperfectly performed, that the lungs varied but little in weight from the average before respiration. (G. H. Rep. No. V.) The truth is, we cannot compare the lungs of children, as to weight, according to the time which they may have survived birth, but rather according to the degree to which the lungs have been penetrated by air. In one instance of alleged infanticide, where the child was probably killed soon after birth, the lungs weighed 1000 grains. In another instance, where the child had certainly lived eight or nine days, the lungs weighed only 861 grains. In the first case, respiration had been perfectly performed; in the second, imperfectly. Therefore, to say that the lungs weigh so much after respiration amounts to nothing, unless we know its exact degree; and any calculations founded upon such dissimilar cases must unavoidably lead to error:—they cannot at all affect the use of the static test, when applied with proper discrimination. This increase in weight after birth is commonly ascribed to the altered course of the blood under the establishment of the respiratory process; and to the fact, that more blood circulates through the lungs after, than before respiration. Practically, this view is confirmed by the contraction of the ductus arteriosus, and the simultaneous enlargement of the two pulmonary arteries; changes which have been occasionally observed where the child has survived its birth only for a very short period. As these changes in the duct depend on the establishment of respiration, so we cannot expect to find them when the process has been imperfectly performed, although the child may have lived several days.

It is impossible to determine a point of this kind by a conclusive experiment; since, in order to ascertain whether the lungs do become increased in weight by respiration or not, we ought to weigh them, in the same child, before and after the process; the comparison of the weight of the lungs in one still-born child, with their weight in another that has breathed, being exposed to the objection that the original weights in the fœtal state may not have corresponded. It is therefore possible for us to compare averages only; and in this way, it must be admitted, an erroneous result may be obtained; since the lungs which have breathed, may be lighter than the average, and those which have not breathed, heavier. Ploucquet considered it probable that the lungs became doubled in weight by respiration: but not to say that the various degrees in which this process is performed by new-born children was entirely overlooked in his calculation, it is not established that this great increase occurs, even under the most favourable circumstances.

It appears to me that the general opinion on this subject is correct, namely, that the healthy lungs of mature new-born children become heavier after respiration, and according to its degree; and where a deviation from this rule is observed, it may probably be explained by the circumstance that the lungs of an immature have been compared with those of a mature child, the lungs of an undeveloped twin with those of one not a twin, or the lungs of one which had breathed imperfectly with those of another in which respiration had become well established. In this respect the extensive tables drawn up by Lecieux appear to me to be faulty, and to lead to erroneous inferences, relative to the effect of respiration on the absolute weight of the lungs. The weights of the organs are noted, but the *degree* to which respiration had been performed is so loosely stated, as to allow of no fair inference of the effect of that process upon the weight. The time which the children survived is stated, but this furnishes no criterion of the degree to which respiration had been carried. Again, we are not informed whether due care was taken to ascertain if the lungs were healthy or diseased. (Considérations sur l'Infanticide, Paris, 1819.)

The following table of the weight of the lungs, in four cases, will show how much the organs are liable to vary in weight after birth according to the degree of respiration.

CASE 1.	CASE 2.	CASE 3.	CASE 4.
Born dead.	Lived six hours.	Lived twenty-four hours.	Lived nine days.
Weight, 687 grs.	774 grs.	675 grs.	861 grs.

Relying upon a table of this kind only, without comparing the other characters of the lungs with the weight, it might be inferred that the organs would weigh less in a child which had survived its birth twenty-four hours, than in another which had been born dead; and that there would be very little difference in the weight, whether the child lived six hours or nine days; but when it is stated, that in case 3 the lungs had every fœtal character possessed by those in case 1, and that in case 4, respiration had been obviously very imperfectly performed,—the difficulty is removed. Such cases should rather be compared with the lungs in the fœtal than in the respired state. They merely show what is very well known to and admitted by all medical jurists, that there are some instances in which the fact of respiration cannot be determined by the application of the static, or any other test to the lungs. But this is certainly no valid reason why evidence from this source is to be rejected in all other cases. It may be fairly granted that the weight of the lungs of some children who have outlived delivery, may not come up to the weight assigned to those of children that have breathed; because, as we have seen, children may survive birth many hours without the process being properly established. On the other hand, as in Chaussier's observations, the lungs of the still-born may be sometimes as heavy as those of children that have respired; but since such lungs would contain no traces of air, it would be impossible to assign the weight above the average in these cases, to respiration. Among such subjects, whatever might be the weight of the lungs, if the facts were unknown, it would be impossible to say whether they were born living or dead. (See Ed. M. & S. J. xxvi. 375. Antè, p. 444.) We must, therefore, not fall into the error of supposing that the lungs increase in weight according to the length of time which a child survives its birth: it is within the limits of a few days, according to the degree of perfection with which a child respires; hence we may meet with cases of children being born alive, surviving some hours or days, and yet after death the lungs will retain the fœtal weight. This is the case in immature subjects, in most twin children and in those which are mature but weakly. In many instances that have come to my knowledge, no difficulty of this sort, however, has occurred. The signs of respiration have been sufficiently well developed to justify a medical opinion, although the child had probably not survived its birth above a few hours, or even minutes. (G. H. Rep. April, 1842.) The cases of imperfect respiration, above alluded to, rarely go beyond a coroner's inquest for want of clear evidence of life. There may be a difference of opinion as to the relative number of instances of perfect and imperfect respiration in new-born children; but the case is never likely to proceed to trial, unless the signs of this process are well-marked; and thus many charged with murder must escape, through the want of sufficient medical evidence to establish the fact of respiration and life.

It is scarcely necessary to observe, that the air which the lungs receive by respiration, cannot add to their absolute weight. This is because they are in the condition of a bladder which weighs the same, whether it be filled with air or empty. The increase of weight is solely due to the additional quantity of blood, which permeates their structure by the altered course of the circulation. Hence it follows that where the lungs are distended with air, either from artificial inflation, or from putrefaction, the fœtal weight will remain unaltered, and by this means it is contended, we may distinguish lungs that have respired from those which have been artificially inflated. Orfila states, that the fœtal lungs weigh more before they are artificially inflated, than afterwards,—a circumstance which may depend upon the fact that the impulsive force employed in inflation, may have forced out a portion of blood or other liquid. In carefully performing this experiment, I have found that there was not even the least fractional difference, but that the inflated lungs weighed precisely the same as in the uninflated state. From what has already been said, it follows, that great weight of the lungs can obviously furnish no proof of respiration, unless this be accompanied by the other physical changes indicative of that process,—as, for example, great increase in volume from the presence of air and crepitation. If the lungs are very heavy, and at the same time contain but little air, it is probable that the increase of weight depends upon disease or other causes,—not upon respiration. It must not be forgotten that all the physical characters presented by lungs that have respired, are liable to certain fallacies; but, as in the evidence derived from tests used in poisoning, these may be removed by not basing an opinion on one or two conditions only. We must take the whole combined; for it would be as wrong to regard great weight in the lungs as an absolute proof of respiration, as it would be to draw the same inference from a mere change in the colour, volume, or consistency of the organs.

5. Test of Ploucquet.—This test for determining whether or not the act of respiration has taken place, was proposed many years since by M. Ploucquet. It is founded on a comparison of the absolute weight of the lungs with the weight of the body of the child. Admitting that the lungs increased in weight from the establishment of the respiratory process, it was supposed that a like difference would take place in the relative weight of these organs to the body; and that the ratios thus procured, compared with certain averages, would enable

a medical jurist to determine in an unknown case, whether or not a child had respired.

Ploucquet conceived that the average ratio of the weight of the lungs to the body in children which had not breathed, was 1 : 70; and for those which had breathed, 2 : 70 or 1 : 35. Subsequent researches, however, made by Chaussier and others, have shown that these numbers cannot be considered to represent the true averages. The most serious objection to the employment of this test, in cases of infanticide, is, that the lungs and the body are liable to vary in their relative weights, in children of the same age; and, à fortiori, this variation must exist to a great extent among children which have reached different ages. There may be various degrees of development in the body of a child, without any necessity existing for a corresponding development taking place in the lungs. It is unnecessary to enter into speculations relative to the causes: experience has shown that such variations really exist; and all that a medical jurist has to consider, is, whether the differences can be reduced within limits which may make the test available in practice. M. Devergie states, from his experiments, that Ploucquet's test affords no satisfactory results, as applied to the bodies of children which have not reached the eighth month of gestation. According to him, the ratio is for the eighth month:—Before respiration, 1 : 63. After respiration, —1 : 37. Ninth month:—Before respiration, 1 : 60. After respiration, 1 : 45. The ratio, he observes, becomes higher after respiration, in proportion to the perfection with which the process has been carried on.—(Médecine Légale, i. 556.)

I have founded the following Table on some cases which I have collected:

Before Respiration.

	Weight of the body.	Lungs.	Ratio.
1.	57,000 gr.	694 gr.	1 : 82
2.	62,660	683	1 : 91
3.	34,540	630	1 : 54
4.	47,170	703	1 : 67
5.	51,890	744	1 : 70
6.	29,460	520	1 : 57
7.	29,966	666	1 : 45
8.	47,025	658	1 : 71
9.	39,370	550	1 : 71

(See G. H. Rep. April, 1842.)

The second and third cases in this table show that there is no sort of constant relation between the weight of the lungs and that of the body; for while the body in No. 2 weighed nearly twice as much as in No. 3, the lungs in the respective subjects differed in weight only by fifty-three grains. Thus, then, it does not follow, as it has often been stated, that when the body is below the average weight, the lungs will also be below the average. There are many facts on record which appear to bear out this view; but the two cases referred to, prove that, in practice, an inference of this kind must be cautiously employed. The ratios, it will be seen, differ so widely from each other, as to render Ploucquet's test a very uncertain guide in infanticidal investigations.

After Respiration.

	Weight of the body.	Lungs.	Ratio.
1.	56,160 gr.	1000 gr.	1:56
2.	34,125	861	1:39
3.	41,788	920	1:45

The comparison of these ratios, obtained from lungs after respiration, with those obtained before respiration, appear to me to show that Ploucquet's test is not fitted to determine, in an unknown case, whether a child has breathed or not.

6. Blood in the pulmonary vessels.—It has been asserted that if blood be found in the pulmonary vessels of a child we are justified in assuming that respiration has taken place. On the other hand, the absence of blood from these vessels has been considered to prove that a child had not respired. This assertion must have originated in a want of correct observation. The pulmonary vessels contain blood, both in the child which has, and in that which has not respired. It is possible that the vessels may contain more after respiration, than before; but in most cases of infanticide, it would be difficult to found any distinction on a point of this nature.

In examining the bodies of children which have died without respiring, and those of others which have lived and respired for some time after birth, no perceptible difference was found in the quantity of blood existing in these vessels in the two cases. The fact is, the excess of blood after respiration becomes distributed through the minute capillary system of the lungs: it does not remain in the larger trunks. The state of the pulmonary vessels, therefore, furnishes no evidence of respiration or the contrary. The same observation will apply to the presence of blood in the substance of the lungs. It is said that on cutting through lungs that have breathed, the incisions are followed by a copious flow of blood; but this, it is alleged, does not happen with lungs that have not breathed. In performing this experiment on several occasions, I have been able to perceive no well-marked difference. The blood in the new-born child may be found coagulated or not, and there is no difference in this condition, whether it be born living or dead.

7. The specific gravity of the lungs.—The specific gravity of the lungs is greater before, than after respiration; for although the organs become absolutely heavier by the establishment of the process, this is owing not to the air, but to the additional quantity of blood received into them. The air thus received, so increases the volume of the organs, as to more than counteract the additional weight derived from the blood, and thus apparently to diminish their specific gravity. Under these circumstances the organs readily float on water. From several experiments, I have found that the specific gravity of the lungs before respiration, i. e. in the fœtal condition, varies from 1.04 to 1.05. They are about one-twentieth part heavier than their bulk of water.

After respiration, the specific gravity of the lungs with the air contained in them, I found in one experiment to be 0.94, i. e. the organs were about one-seventeenth part lighter than their bulk of water. Thus it is that a very small quantity of air will render these organs buoyant in water; and an alteration in the volume of the lungs required for this purpose, would not be perceptible to the eye. It will be understood that the specific gravity of the substance of the lungs is unchanged; they are rendered only apparently lighter by the air contained in their cells on the same principle as a distended bladder. Hence it follows, that the same apparent diminution of specific gravity, will take place whether the air be derived from respiration, artificial inflation or putrefaction. It is on this property of the lungs that the application of what is termed the hydrostatic test, or the docimasia pulmonaris, is founded,—a subject which may be more appropriately considered in another chapter.

CHAPTER XLV.

THE PROOFS OF A CHILD HAVING LIVED AT ITS BIRTH. THE HYDROSTATIC TEST. DOCIMASIA PULMONARIS.

The hydrostatic test has been long known, and various opinions have been entertained relative to its efficiency and value. Many of the objections that have been urged to its use, appear to have arisen from a mistaken view of the evidence which it is capable of furnishing. It is assumed, that when properly applied and with a full knowledge of the exceptions to which it is exposed, it may afford in many cases good evidence as to whether a child has or has not respired. The mode of performing the experiment is extremely simple. Having removed the lungs from the chest, they should be placed still connected by the trachea and bronchi upon the surface of distilled or river water. If they sink, it should be noted whether the sinking take place rapidly or slowly. If they both sink, the two lungs should be tried separately; for it is sometimes found, that one, commonly the right, will float while the other will sink. Supposing that both lungs sink, it will then be proper to divide each into twelve or fifteen pieces, and place these pieces separately on water. If, after this, they all sink, the inference is, that although the child may have lived and survived its birth, there is no evidence of its having respired.

On the other hand, the organs when placed on water may float,—it should then be noticed whether they float high above the surface, at or below the level of the water; sometimes they will indifferently float or sink. These differences will lead to a conclusion respecting the degree to which respiration has taken place. It will now be proper to separate the lungs, and determine whether the buoyancy be due to one or both. Each lung should then be divided as before, and each piece separately tried. If all the pieces float, even after firm compression, we have good evidence, cæteris paribus, that respiration has been very perfectly performed. Should any of the divided portions sink in water either before or after compression, our opinions may be accordingly modified. Some have recommended that the lungs should be placed on water with the heart and thymus gland attached; but there appears to be no good reason for this, since it is as easy to form an opinion of the degree of buoyancy possessed by the lungs from the readiness with which they float, as by observing whether or not they have the power of supporting these two organs.

Such, then, is the method of employing the hydrostatic test in cases of infanticide. With regard to its use in medical jurisprudence, it should be observed that the floating of the lungs in water is not, as it is often incorrectly represented to be, a proof that the child has been *born alive:* nor is the fact of their sinking in water, any proof that the child was *born dead.* The floating under the limitations to be now described, proves only that a child has *breathed;* the sinking, either that it has *not breathed* or breathed but imperfectly. The fact of a child having been *born* living or dead, has no relation whatever to the employment of the hydrostatic test under any circumstances. There are cases of infanticide which may be readily established without resorting to this test: all that the law requires is proof of a child having been born living,—whether this proof be furnished by the state of the lungs through the hydrostatic test, or in any other way, is of no moment. The signs of life are commonly sought for in the lungs, because it is in these organs that the changes produced by a new state of existence, are first perceived; but this examination may be dispensed with, where the woman confesses that the child was born alive—where others have seen it manifest life by motion or otherwise after its birth, or lastly, in cases, where, without being seen, it was heard to cry. The crying of a child has been admitted as evidence of live birth on several trials for infanticide; although from what will be hereafter said, it is possible that a child may be heard to cry and die before its body is entirely born.

OBJECTIONS TO THE HYDROSTATIC TEST.—1. SINKING OF THE LUNGS. It is said that the test cannot always show whether a child has or has not survived its birth; because the lungs of children that have lived for many hours, have been observed to sink entirely in water. In some instances this may depend on disease, tending to consolidate the air-cells, as hepatization or scirrhus; in others, on œdema or congestion; but this cause can create no difficulty, since the reason for their sinking in water, would be at once obvious. The hepatized portion of lung may be known by the firmness which it evinces on cutting it with a knife, as also by the fact, that it is impossible to distend it artificially with air. On the other hand there are cases in which the lungs appear healthy and unaffected ; all that we can perceive is, that they retain their fœtal condition. This is a very different state to that of hepatization, because the lungs may, in this case, be made to receive air by artificial inflation. It is remarkable that life should continue for many hours, and sometimes for days under such a condition ; but the occasional existence of this state of the organs in a living child, is placed beyond all dispute; the explanation of the causes upon which it depends—how it is that a child may live and breathe for hours or days, and that no signs of respiration be discovered in its body after death—is involved in great difficulty. The late researches of Dr. E. Jörg, of Leipzig, have, however, thrown some light upon the subject; and these may probably lead the way to other discoveries in this obscure department of physiology. Some of Dr. Jörg's views are peculiar. He considers that the act of parturition, as well as the duration of the process, has a material influence upon the system of a child; and that they serve to prepare it for the efforts which it has to make in performing respiration. (Die Fötuslunge, Grimma, 1835.) Supposing the first inspirations made by a child to be, from any cause, feeble or imperfect, then the organs will become only partially distended ; the remaining portions will preserve their fœtal condition. Dr. Jörg considers this as a positively diseased state of the lungs in the new-born child, and he has given to it the name of "atelectasis; (ἁτελὴς "incomplete" ; ἔκτασις "expansion.") It may proceed from various causes. He considers, that children which are born after a very easy and rapid delivery are liable to it; and thus it may be found in a mature, as well as in an immature child. Any cause which much weakens the vital powers of a child before its actual birth, may give rise to the occurrence of this imperfect dilatation of the lungs. In this way, it may be due to long-continued pressure on the head during delivery, or to hæmorrhage from the cord. All the causes of asphyxia in a new-born child, will, when operating even in a very slight degree, also produce this atelectasic condition. When only a part of the lungs becomes, in the first instance, distended, the child may not afterwards acquire sufficient strength to fill the remaining portions ; it may thus live on for some hours or days, respiring at intervals, and becoming occasionally convulsed, in which state it will probably sink exhausted and die. Jörg has remarked, that those portions of the lung which are not speedily distended by air, afterwards become consolidated or hepatized, so that all traces of their vesicular structure are lost. The length of time which the child survives, will depend upon the degree to which its lungs have become dilated.

It is not necessary that the whole of the lungs should have received air, in order that a child should continue to live even for some months after its birth. A few years ago, I met with the following case, which will serve to illustrate this statement. A child, aged six months, had, it was supposed, been destroyed by suffocation. Upon opening the thorax, the viscera were found healthy ; but the whole of the inferior lobe of the right lung was, so far as regarded colour, density and structure, precisely like the lungs of the fœtus: no air having ever penetrated into it. It had become developed in size, but its vesicular structure was perfectly destroyed. When the whole of the lung was placed in water, it floated; but when the inferior lobe was separated, it immediately sank to the bottom of the vessel. I have no doubt that this was a case of atelectasis, such as it is described by Jörg. The lobe had not received air in the first instance; and had become afterwards consolidated or hepatized, so that it would not be inflated.

Dr. Albert met with a case, where a child died thirty-six hours after its birth, having been attacked by convulsions at intervals during that time. On inspection, the whole of the right and the lower lobe of the left lung, were found to be in their fœtal condition, and they immediately sank when immersed in water. There was no diseased appearance in the organs, and the undistended portions were easily filled by blowing air into them. (Henke's Zeitschrift. 1837, ii. 422.)

It is quite necessary for a medical jurist to be aware, that this state of the lungs which is here called atelectasis, is by no means unfrequent among new-born children, although attention has only been of late years drawn to the subject. When no portion of air is found in the lungs of a child, there is no test by which such a case can be distinguished from one where the child has come into the world dead. These cases of atelectasis are ordinarily set down as exceptions to a very general rule; but I cannot help thinking, that they are more common than some medical jurists are inclined to admit. In examining the body of a child, the history of which is unknown, it is therefore proper, that the possible occurrence of these cases should be well borne in mind. It appears to me not improbable, that many such come yearly before coroners in this country; and that they are dismissed as cases of still-born children, notwithstanding that marks of violence are often found upon the bodies. If, as it has been already observed, the lungs sink in water, the fact is commonly regarded as sufficient evidence of still-birth. This is assuredly putting the most humane interpretation on the circumstances; and so far the result is not to be objected to; but we should take care, in carrying out this principle, that we do not throw obstacles in the way of judicial inquiry, and lead to the concealment of crime.

Professor Bernt met with an instance, in which a seven months child died two hours after birth; and when its lungs were divided and placed on water, every fragment sank. Remer has reported another, in which the lungs sank in water, both entire, as well as when divided, although the child had survived its birth at least four days. (Henke. Lehrbuch der G. M. p. 374.) In this case, the navel-string separated naturally before death. Orfila found, in a child which had lived eleven hours, every portion of the lungs, when divided, to sink on immersion. In three other cases, in which the subjects survived birth, four, six, and ten hours, the lungs also sank when divided; two of these were mature children. (Méd. Lég. i. 375. Other instances are recorded by Daniel, Schenk, and Osiander. Metzger supposed that premature children alone were likely to present this anomaly; i. e., of continuing to live after birth without leaving any clear signs of respiration in their lungs. Perhaps the greater number of these cases have occurred among premature children; but recent observations satisfactorily prove, that perfectly mature children may also be the subjects of this singular condition.

I may add to these instances, two which have occurred under my own observation. In one, the case of a mature male child, the lungs sank in water, although the child had survived its birth for a period of six hours. In the other, the case of a female twin, the child survived twenty-four hours; and after death the lungs were divided into thirty pieces; but not a single piece floated, showing, therefore, that although life had been thus protracted, not one-thirtieth part of the structure of the lungs had received sufficient air from respiration to render it buoyant. (Guy's Hospital Reports, No. 5, p. 47.) In the latter instance no particular remark was made respecting the respiration of the child. These cases show most clearly that buoyancy of the lungs is not a necessary consequence of a child having lived and breathed for some time after birth. Probably, had this been a case calling for medico-legal inquiry, the lungs would have been cut to pieces; the sinking of the divided pieces in water, either before or after compression, would have been set down as negativing the act of respiration, and, unless other strong evidence were forthcoming, the fact of the child having survived its birth. Here, again, we perceive the necessity of not hastily assuming that a child has been born dead, because its lungs sink in water. There may be no good medical evidence of such a child having lived after birth; but assuredly the mere sinking does not warrant the common dictum, that the child was necessarily dead when born; it would be as reasonable to pronounce, in a question of poisoning, that the fact of an individual having died from poison, was negatived by the non-discovery of a poisonous substance in the stomach of the deceased.

It must be apparent, on reflection, that cases of this description are beyond the reach of the hydrostatic as well as of all other tests applied to the respiratory organs, because the lungs do not receive and retain a perceptible quantity of air, although the subjects may have lived some hours. The hydrostatic test is no more capable of showing that such subjects as these have lived, than it is of indicating from what cause they have died. Facts of this kind, demonstrate that existence may be for some time continued under a state of the respiratory process, not to be discovered after death. In the opinion of some, these cases form a serious objection to the hydrostatic test; but it is difficult to understand how they can affect the general application of it or why, because signs of respiration do not always exist in the lungs of children which have lived, we are not to rely upon them when they are actually found. Poison is not always discoverable after death, in the stomach of a person who has taken it; but this does not prevent a medical jurist from searching for it, and relying upon its discovery under proper precautions as evidence of poisoning in any other case.

These singular instances prove that we are greatly in want of some sign to indicate life after birth, *when the marks of respiration are absent.* Until we discover this, we must, of course, make the best use of that knowledge which lies at our disposal; taking care to apply it to those cases alone to which experience shows it to be adapted. In the mean time, the common inference that a child has been born dead because its lungs sink in water, is never likely to implicate an innocent party; it can only operate by sometimes leading to the liberation of the guilty. From the cases already reported, it is a fair subject of consideration, whether a great error is not committed by those medical practitioners who pronounce all children to have been born dead, merely because the lungs contain no air, and readily sink when placed on water. This, it is true, is the common opinion, but it is not warranted by observation. We are only entitled to say, in all such cases, that there is no evidence of a child having breathed or lived.

Many might be disposed to consider it an unnecessary degree of refinement, to hesitate to express an opinion that a child was born dead when its lungs sank entirely in water, because certain cases have occurred wherein these characters have been possessed by lungs taken from the bodies of children that have survived their birth many hours. To those inclined to adopt this view, I would say, the answer to such a question is of far greater importance in a medico-legal, than in a medical light. In the latter case, no responsibility can be attached to the expression of the opinion commonly adopted; in the former case, however, when the question refers to child-murder, a serious responsibility attaches to a practitioner; and he can only guard himself from unpleasant consequences, by basing his evidence on carefully-observed facts.

If a child can live for six or twenty-four hours, without its lungs receiving sufficient air to allow even one-thirtieth part of their substance to float, it is clear that such a child may be the subject of a murderous assault. If a medical practitioner, losing sight of this fact, proceeds to declare, from the lungs sinking in water, that the child must have been born dead, his assertion may afterwards be contradicted, either by circumstances, by the testimony of eye-witnesses, or by the confession of the woman herself. He will be, perhaps, required to revise his opinion; and he will then find, that the fact of the lungs sinking in water is rather a want of evidence of life after birth, than a positive proof of a child having been born dead. It cannot be denied, that the sinking of the lungs is a presumption in favour of still-birth, but it is nothing more;—it is not, as it is often set down, an affirmative proof of the child having been born dead.

There are many cases reported which show that this is not an unnecessary caution. Meckel relates two instances where the lungs sank in water, but the women respectively confessed that they had destroyed their children; according to the general rule, these children must have been born dead, and no murder could have been committed! (Gerichtl.

Med. 365.) For other examples of a similar kind, I must refer to the following works: Ann. d'Hyg. 1837, i. 437; also, 1841, 429; Henke's Zeitschrift, 1840, xxvii. Erg. h.; Brit. and For. Med. Rev. Jan. 1842, p. 250. The cases there reported appear to me to convey a serious warning to medical witnesses.

It is a matter of surprise, that in the later editions of his work, Dr. Beck should have asserted, that "it is both safe and just to consider as dead, every child that has not breathed; i. e., whose lungs sink in water. (Med. Jur. 284.) He, however, admits that children may come into the world living without breathing; and the law holds under the decisions of its expounders, (see antè, p. 441,) that respiration is only one, and not the exclusive proof of life. In order to establish life or even live birth, respiration need not always be proved, either in civil or criminal cases. (Fish v. Palmer, 1806. See post, BIRTH.) A medical jurist would therefore be no more justified in asserting that all such children were necessarily born dead, than that they were born living; and in stating what is the plain and obvious truth, it is not possible that he can ever be the means of involving an innocent person. It is certain, however, in departing from the truth, and stating what is contrary to well-known facts, that when the lungs of a child sink in water, it is safe and just to consider such child as dead, he is incurring the risk of exculpating a really guilty person; for it cannot be too strongly borne in mind, that a woman is not charged with murder, merely because the lungs of a child float or sink in water; but because there are on its body, marks of violent injuries apparently sufficient to account for the death of a new-born child, or very strong moral presumptions of her guilt.

II. BUOYANCY OF THE LUNGS FROM OTHER CAUSES.—It is said that the lungs may receive air and acquire buoyancy from other causes than respiration. Of this fact there can be no doubt. These causes are two: putrefaction and artificial inflation. It was supposed, that the lungs of a still-born child might become emphysematous from a compression of the sides of the thorax during delivery; but it is difficult to understand, how in this way, air should be extricated from these organs any more than it would from the liver under similar circumstances. The truth probably is, that what has been described as emphysema of the lungs in still-born children, was nothing more than partial or imperfect respiration, performed during delivery. In examining the bodies of many still-born children, I have never met with any appearance resembling what has been described as a state of emphysema, independent of respiration and putrefaction.

1. *Putrefaction.*—The lungs of a still-born child when allowed to remain in the thorax, are slow in undergoing putrefaction; but, nevertheless, they may sooner or later acquire sufficient air to render them buoyant in water. This form of gaseous putrefaction, may even take place in the lungs of a child which has died in utero. One instance of this kind is recorded by Dr. Albert. (See Henke's Zeitschrift 1837 ii. 379. In this case, the child was cut out of the uterus

in a putrefied state, and its lungs floated when placed on water. It has been supposed, that the formation of air may take place in the lungs from putrefaction without this being indicated by change in colour, smell, or other properties of the organs; but further observations are required before such a supposition can be admitted as probable.

When the lungs are putrefied, this will, in general, be indicated by putrefaction having extended throughout all the soft parts of the body. The organs, according to the degree of putrefaction, will be soft, pultaceous, of a dark green or brown colour, and of a highly offensive odour; the serous membrane investing the surface, will be raised in large visible bladders from which the air may be forced out by very moderate compression. It has been remarked, that under the same conditions, gaseous putrefaction takes place as rapidly in the liver, heart and thymus gland of a new-born child, as in the lungs. We should, therefore examine the general condition of the body; the distension of the lungs with gas from putrefaction cannot be easily overlooked nor mistaken for the air of respiration. The answer to any objection founded on the putrefied state of these organs, must at once suggest itself. It is impossible that any well-informed medical witness can expect to obtain satisfactory evidence from experiments on the lungs of such subjects. He should at once abandon the case, and declare that in regard to the question of respiration, medical evidence cannot establish either the affirmative or the negative. The fact of his not being able to give the evidence required, cannot be imputed as a matter of blame to him; because this is due to circumstances over which he has no control. In a case of poisoning, the post-mortem appearances in the viscera may be entirely destroyed by putrefaction; but no practitioner would think of looking for proofs where the circumstances rendered it utterly impossible for him to obtain them.

A case may possibly occur, wherein the characters presented by the lungs will be such as to create some doubt in respect to whether the buoyancy of the organs be due to putrefaction or respiration, or what is not unusual, whether the putrefied lungs may not also have undergone the changes of respiration. The facts may be explicable on either assumption. In such a case, it has been recommended that the witness should lean to the side of the prisoner,—in other words, he should give an opinion, that the child suspected to have been murdered, had not respired. This advice is equal to recommending a witness to take upon himself the duty of a jury, and virtually to acquit a prisoner upon a doubt existing in his own mind in respect to only one portion of the evidence adduced against her. The ill effects of following this kind of advice is well seen in a case reported in Henke's Zeitschrift, (1840, i. 102, Erg. h.) where an opinion was improperly given by a medical witness, that the child, the whole of the organs of whose body were in an advanced state of putrefaction, was born dead; and the prisoner afterwards confessed that it had been born living! This shows that it is always better to leave a doubtful case as we find it, than to express a positive opinion on one side or the other, which can never amount to more than a conjecture. If a witness were simply to assure the jury, that medical evidence could not solve the question whether the child had lived,—if he were to assert what is really the fact, that his experiments would not allow him to say, whether the child had or had not respired,—it is certain that no innocent person would ever be convicted, or a guilty person acquitted upon his evidence. It is for a jury only to judge of guilt from the circumstances laid before them; but it is assuredly not for a medical witness to drown all further investigation and put an end to the case, by leaning to the side of the accused, when there is really a doubt upon his mind. It is his duty to state that doubt, and leave the decision of guilt or innocence in the hands of the court.

2. *Artificial inflation.*—It has been alleged that the lungs of a still-born child, may be made to assume, by artificial inflation, all the characters assigned to those, which have undergone respiration. Thus, it is said, a child may not have breathed, and yet the application of the hydrostatic test would lead to the inference that it had. It will be seen that the force of this objection, goes to attack directly the inference, derived from the presence of air in the lungs. The objection can, it appears to me, be admitted only under one form, namely, as it applies to lungs which have been inflated while lying in the cavity of the chest. Any experiments performed on inflation after their removal from this cavity, can have no practical bearing; since in a case of infanticide, we have to consider only the degree to which the lungs may be inflated by a person who is endeavouring to resuscitate a still-born child. The difficulty of inflating the lungs of a new-born child, is too well known to require to be here adverted to; the greater the violence used, the less likely is the air to pass into these organs; but it rather finds its way through the œsophagus into the bowels. Dr. Albert, a late writer on the subject, denies that the organs while lying in the chest can be so filled with air, either by the mouth or by means of a tube, as to be rendered buoyant in water. In performing this experiment several times, he never found a trace of air in the air-cells, and he contends that medical jurists have begun at the wrong end (den Gaul von hinten aufgezäumt,) in endeavouring to seek for answers to an objection, before they had ascertained that such an objection could have any valid existence (Henke, Zeitschrift, 1837, ii. 390.) Having had several opportunities of examining the lungs of children in which inflation had been resorted to, not for the purpose of creating an objection to the hydrostatic test, but with the bonâ-fide intention of resuscitating them, I may here state the results. In some of these instances, a tube had been used, and in others the mouth. In the first case it was found on inspection, that only about one-thirteenth part of the structure of the lungs had received air. In the second, no part of the lungs had received a trace of air, although inflation had been repeatedly resorted to; the air had passed entirely into the abdomen. In a third, attempts were made for upwards of half an hour to inflate the organs; but on examination, not a particle of air was found to have penetrated into them. In a fourth, no air had entered the lungs, and in a fifth,

although a small portion had penetrated into the organs, it was readily forced out by compression. In repeatedly performing experiments on dead children, the results have been very similar; the lungs, after several attempts, were found to have received only a small quantity of air.

Thus, then, it would appear, that the lungs of a new-born child may be inflated in situ, although with some difficulty, and that the quantity of air which they receive under these circumstances, is inconsiderable. If the efforts at inflation are continued for some time in the dead body, and the tube is violently introduced into the larynx or trachea; or if the organs be inflated, after removal from the thorax, with the express intention of causing them to resemble respired lungs, the case is different: but this is not the way in which the objection can possibly occur in a case of infanticide,—a circumstance which appears to have been often strangely overlooked by those who have examined this alleged objection to the hydrostatic test. It is not likely that a woman, if able to perform the experiment at all, would be capable of doing more than a practised accoucheur; and the probability is, that she would, in general, altogether fail in the attempt. I have been able to find only one case reported where a woman is stated to have succeeded in artificially inflating the lungs of her child.—(Meckel, Lehrb. der G. M. 368.—See also Ed. Med. and Surg. Jour. xxvi. 374.)

But let it be admitted, that the lungs are artificially inflated; in this case, they would resemble, by their partial distension with air, low weight, and other physical characters, those of children which had imperfectly breathed. Like these, they may float on water; but on cutting them into pieces, some of these would be found to sink. If the pieces be firmly compressed either by means of a folded cloth or between the fingers, they will lose their air and sink, so that in fact there are no physical means of distinguishing artificially inflated lungs from those that have imperfectly breathed. Experiment has repeatedly shown that where the respiration has been very feeble and no artificial inflation resorted to, the air may be forced out of the lungs by moderate compression, and the portions so compressed will sink in water. If the compression be performed under water, the bubbles of air may be seen to rise through the liquid. The results are exactly the same with lungs artificially inflated as they are lying in the chest. (See Guy's Hospital Reports, No. 5, and for remarks on this subject by Dr. Christison, see Ed. Med. and Surg. Jour. xxvi. 74.)

If respiration has been perfectly established and the lungs are well filled with air, it is impossible so to expel this air by compressing the divided portions of the organs, as to cause them to sink in water. It has been asserted, that it is equally impossible to force the air out of lungs that have been artificially inflated; but it is highly probable that in these cases the lungs had been inflated to a maximum degree when removed from the thorax, a case in which much difficulty is certainly experienced in expelling the air; but this is not the form in which the objection can ever present itself in a case of infanticide. If the lungs be inflated in the ordinary way, i. e., while lying within the thorax, there is never, according to my observations, any great difficulty in causing them to lose their air by compression, a result which has been repeatedly demonstrated to the medico-legal classes of Guy's Hospital. Although no reliance can be placed on the effects of compression in respect to cases of imperfect respiration, yet it appears to me that when with great weight of the lungs, there is great buoyancy in water, the fact of their not losing the air contained in them, and not sinking after firm compression, ought to be considered as a good corroborative proof of a child having breathed.

It has been just stated, that compression will not extricate air from lungs which have fully respired. By this, it is not to be understood that the experiment of compression can only be practically applied, to distinguish respiration, in those cases in which a child has lived for a considerable time after its birth. I have found it to succeed, even where a child had lived to make no more than one or two respirations, and had died before it was actually born. In this case, it was found necessary to destroy the child while the head was presenting, in order to effect delivery. It lived, however, a sufficient time after the protrusion of its head with the greater part of the brain evacuated, to cry loudly for an instant. The general appearance of the body showed that it had attained to the full period of gestation. On opening the thorax, the lungs were seen projecting slightly forwards over the sides of the pericardium. They were of a light-red colour, but not crepitant under the finger. They had the external physical characters which these organs are known to acquire on the first establishment of respiration; but the absence of crepitation proved that the process could not have been perfectly performed. The colour of the external surface was throughout uniform; a circumstance which I have never witnessed in lungs that had been artificially inflated, except where the inflation had been carried to its fullest extent out of the body. Then, however, there is, commonly, distinct crepitation.

When removed and placed on water, these organs floated freely; and on being separated, both appeared equally buoyant. Each lung was next divided into sixteen pieces, and every piece floated. In dividing them, it was observed that the colour was uniform throughout their substance; there was no sense of crepitus under the knife; nor could the cells, in which the air was diffused, be seen. The pieces were then subjected to a very forcible compression, for a considerable time, in a folded cloth. The cloth was ruptured by the force employed; yet, on removing the pieces, and placing them on water, they all continued to float. A portion of air had, undoubtedly, been forced out, but not sufficient to deprive any of them of their buoyancy. By this we learn, that in some instances, two or three respirations only, may suffice to stamp upon the lungs, characters whereby they may easily be distinguished from those organs that have undergone artificial inflation. The compression was carried to the furthest possible limit consistently with the preservation of the organic structure of the lungs.

It must not be supposed, that, in all children which have lived but a second or two to respire, similar results will be obtained. The respiration of an instant may distend the lungs of one child, as much as respiration, continued for several hours, would those of another. The time which a child has survived its birth, does not allow us to predict, to what degree its lungs will be found distended on inspection, or what the results of experiments on those organs will be. A child may have very feebly respired, and died either in a few minutes or hours, or not until many days have elapsed after its birth. There is, of course, no definite boundary between the perfect and imperfect distension of the lungs, but by the latter condition we may understand that state of the healthy organs in which they contain only sufficient air to render them buoyant in water; and from the slight difference in their specific gravity and that of water, a very small quantity will suffice for this. In these cases, moreover, the colour, volume, and consistency, are scarcely changed from the fœtal condition.

The admission, that air may be compressed out of feebly respired lungs by the same means as out of those which have been submitted to artificial inflation, may appear to render compression useless, as a diagnostic sign of artificial inflation; but we must not forget, that other corroborative sources of evidence may be forthcoming. The experiment of compression will distinguish all cases of complete respiration from those of artificial inflation; and, if for this circumstance alone, it ought to be regarded as an adjunct, occasionally useful in these investigations.

It must, however, be admitted, that there are no means of distinguishing feeble respiration from artificial inflation. The physical characters of the lungs will be unaltered; and compression will, in either condition, destroy their buoyancy. In a case of this kind, I apprehend the only course left open to a medical witness is, to state to the jury, that the evidence derived from experiments on the lungs, left it uncertain whether the child in question had respired or had had its lungs artificially inflated. The jury will then know how to return their verdict; for it must be remembered, they have always circumstances to guide their judgment, as well as medical opinions; and it is upon the whole, and not upon a part of the evidence laid before them, that their verdict is founded.

It is singular that this occasional difficulty of distinguishing artificial inflation from respiration should have been represented as a serious objection to the employment of the hydrostatic test. Even admitting, in the very few instances in which such a defence on the part of a prisoner is possible, that a practitioner is unable to distinguish the one condition from the other, this becomes purely a point for the consideration of a jury; it cannot affect the general application of the hydrostatic test. Examples of this sort of difficulty are by no means uncommon, in the practice of medical jurisprudence. Thus, to take what appears to me a parallel case:—A man, while labouring under symptoms of cerebral disease, receives a blow on the head: he dies in five or six weeks afterwards, and a considerable abscess is found in the brain. A witness is asked to state, whether the abscess resulted from the blow, or from previous disease. He is in doubt; and he expresses that doubt to the court. But, because he is unable to give a positive opinion in this instance, he would not be justified in abandoning the ordinary rules of surgical diagnosis in any future instance of a similar kind that came before him. Again, the stomach in a case of suspected poisoning, is found inflamed or perforated; and a medical witness may be unable to swear, whether the appearances were due to poisoning or disease in that particular instance. But this will not prevent him from relying, in general, upon morbid appearances, as a good source of evidence in all future cases. Many other instances might be adduced of medical evidence becoming doubtful from circumstances, wholly independent of the will of the practitioner, and over which he has no possible control. In the determination of any single point in a case of child-murder, whether it relate to live birth or the actual cause of death, a doubt may arise; the question relative to the respiration of the child is not exempted from this rule; but it would be the height of inconsistency, to contend, that, because certain means of investigation will not always enable us to express a positive opinion, we should never have recourse to them.

I presume that, in the present day, no practitioner would trust to the floating of the lungs as a sign of respiration, before he had ascertained that the air contained in them could not be expelled by compression. The charge against an accused party is not likely, therefore, to be sustained by medical evidence of the respiration of the child, unless the child have actually respired; but it is possible, that, owing to a want of evidence to characterize feeble respiration, a really guilty person may escape upon the bare assumption that the lungs might have been artificially inflated. The mischief to be apprehended is not then, as it has been often alleged, that the employment of the pulmonary tests may lead to the condemnation of an innocent, but rather to the acquittal of a guilty person. This is certainly an unfortunate circumstance; but it is one for which medical science is not yet in a condition to provide an adequate remedy.

In reference to this objection, there are, it appears to me, only two cases which might give rise to some doubt on the source of the air contained in the lungs of a new-born child:—

1. When in a child that has not breathed, the lungs are disproportionately heavy, weighing nine hundred or one thonsand grains, and they have been artificially inflated in the attempt to resuscitate it. Unless, in this case, the air were expelled by compression, an inference might be hastily drawn, that the child had probably breathed. The error could only be removed by circumstantial evidence, which, however, is generally sufficient to remove a speculative objection of this kind. But unless the fœtal lungs were highly congested, diseased or

of extraordinary size, it is not likely that they would weigh so much as is here supposed. This kind of doubtful case might always be suspected to exist where, with considerable absolute weight, the lungs contained very little air.

Let us, however, consider what would be the practical bearing on the question of child-murder, supposing the case not to be cleared up by any of the methods above suggested. 1st, The fact of respiration would not be clearly proved, because the great absolute weight of the lungs, without their being fully permeated with air, amounts to nothing. 2dly, Although the proof of respiration might not be made out, this would not show that the child was born dead; for we know that a child may live many hours, and yet no evidence of life may be derived from an examination of the lungs. 3dly, Admitting that there was proof of the child having lived after birth, whether there were evidence of respiration or not, the cause of death would have still to be made out; and unless this be clearly traced to the wilful and malicious conduct of the prisoner—proofs of which are not likely to be derived from the body of a child whose lungs she has innocently inflated—she must be acquitted. Thus, then, it is difficult to understand how, in the hands of one who has attended to the subject of infanticide—and no others ought to be allowed to give medical evidence—this objection, on the ground of inflation, can lead to any difficulty whatever in practice. Such a case, as that which I have here supposed, actually occurred to me in June 1842. A male child, weighing upwards of twelve pounds, died during delivery in a difficult labour. It gave no signs of life when born, and there was no pulsation in the cord. Its lungs were artificially inflated in the attempt to resuscitate it. The organs weighed nine hundred and ninety-four grains. They were slightly crepitant and floated on water, but gentle pressure with the fingers, caused them to sink. It was clear that the increased weight depended on their great size, and not on any change wrought by respiration. They contained but a very small quantity of air, which was most easily expelled by pressure.

2. We will now take the converse objection. A child may live and breathe, and its lungs weigh much under the average of respired lungs, i. e., about seven hundred grains. In a case like this, unless the air resisted expulsion by compression, an opposite mistake might be made, and we should pronounce a child that had really breathed and survived birth to have been still-born, and had its lungs artificially inflated. This might happen in numerous cases of imperfect respiration after birth, did we not know that the sinking of the lungs, whether containing air or not, and whether this air be expelled by compression or not, does not prove that the child was born dead. It can only show, under the most favourable circumstances, that it has either not respired, or respired imperfectly. The sinking of the lungs may take place in a child that has survived birth and has really been murdered; but, in such a case, there might be no proofs of life; and therefore a person actually guilty of a crime must be discharged for want of sufficient medi-

cal evidence to convict. This, however, could no more justify the entire abandonment of medical evidence in such cases, than it could of general evidence; because this, like that which is purely medical, is but too often insufficient to bring home guilt to the really guilty. The objection, then, on the ground of artificial inflation, is more speculative than real. Admitting that there is no positive criterion to distinguish this condition from respiration, it is difficult to conceive a case in which it could be sustained; and if sustained, it never could lead, in the hands of proper witnesses, to the inculpation of the innocent:—unfortunately for society, it would only add another loop-hole to the many that, through the necessary forms of law, now exist, for the escape of the guilty.

In concluding these remarks upon the objections to the hydrostatic test, it may be observed that medical practitioners have differed much at different times, in their ideas of what it was fitted to prove. About fifty years ago, it would seem that this test was regarded by some as capable of furnishing evidence of murder! Thus, we find Dr. Hunter asking the question "How far may we conclude that the child was born alive, *and probably murdered by its mother,* if the lungs swim in water?" Later authorities, and, indeed, many in the present day, assert that the test is capable of proving whether a child has been *born alive* or not. (Beck's Med. Jur. p. 268.) From what has already been stated, as well as from the most simple reflection on the circumstances accompanying the birth of children, I think it must be evident, that the hydrostatic test is no more capable of showing that a child has been born alive or dead, than it is of proving whether it has been murdered, or died from natural causes. The majority of those who have made experiments on this subject, have only pretended to show, by the use of this and the other tests, whether or not a child has breathed,—they merely serve to furnish in many cases good proof of life from the state of the lungs; and slight reflection will render it apparent that, in no case are they susceptible of doing more. Even here, their utility is much restricted by numerous counteracting circumstances, a knowledge of which is essential to him who wishes to make a practical application of the facts connected with them. For a very reasonable view of the pulmonary tests, (see Ed. Med. and Surg. Jour. xxvi. 365.) If asked to state in what cases the pulmonary tests are capable of assisting a medical jurist, the answer, it appears to me, would be:—1st, They will clearly show that the new-born child has lived, when, during its life, it has *fully and perfectly respired.* Cases of this description form a certain number of those which come before our courts of law. To them, the most serious objections are not applicable; and the few which might be made to the medical inferences are not difficult to answer. 2dly, They will allow a witness to say, that the lungs must have either received air by respiration, or by artificial inflation. These are the cases in which a child has died soon after birth, and where the respiratory changes are but very imperfectly manifested in the lungs. They probably form the large majority of those that fall under the jurisdiction of the criminal law. It might be considered, that the qualification in the inference here drawn would neutralize its force; but it must be remembered, that there are few instances of actual and deliberate child-murder, wherein artificial inflation could become even a possible defence for an accused party. So unusual is this kind of defence, that among the numerous trials for infanticide which have taken place in this country for many years past, I have not been able to meet with a single instance in which it was alleged, as an objection to the evidence derived from the buoyancy of the lungs, that the prisoner had inflated them in order to resuscitate her child. The reason is obvious: had such a defence been attempted, the whole of the circumstantial evidence would at once have set it aside. When, in the suspected murder of an adult, a medical man swears that a fatal wound was such, as that the deceased might have inflicted it on himself, or that the prisoner might have produced it, he is placing the jury in a very similar position to that in which he places them in a case of child-murder, when he says that the child might have breathed, or its lungs might have been artificially inflated. How would a jury decide in the two cases? Assuredly, by connecting together certain facts with which a medical witness has no concern, but which may, in their opinion, satisfactorily supply the place of what is defective in his evidence. It is not for him to calculate the probabilities of respiration, or of artificial inflation; but it is for them to consider, whether an accused party was or was not likely to have resorted to an experiment of this nature. It has been suggested, that some person might inflate the lungs of a dead child, in order to raise a charge of murder against the mother. Such a person must be profoundly versed in the difficulties of medical jurisprudence;—but the question of *murder* does not happen to depend on the presence of air in the lungs. A case of this kind is very unlikely to present itself; indeed its occcurrence is no more probable than that in poisoning it should be considered a good defence, that some person might have introduced poison into the stomach after death. The circumstances of the case will commonly furnish a sufficient answer to such hypothetical views.

The hydrostatic test ought not, therefore, to be lightly condemned, or rejected upon a speculative objection, which, in nine-tenths of the cases of child-murder, could not possibly exist. Let it be granted to the fullest extent, that a conscientious medical jurist cannot always draw a positive distinction between respiration and artificial inflation—still the jury may be in a situation to relieve him from the difficulty. In short, it would be as reasonable to contend that all murderers should be acquitted because homicidal are not always to be distinguished from suicidal wounds, as to argue that all cases of infanticide should be abandoned because these two conditions are not to be known from each other by any certain medical signs. If juries do frequently dismiss such cases, it is, I apprehend, to be ascribed rather to their great unwillingness to become the means of administering severe laws, than to their want of power to balance and decide on the probabilities laid before them.

If the pulmonary tests were wholly set aside, it is easy to conceive what would be the consequences. Thus, let us suppose that a new-born child is found, under suspicious circumstances, with its throat cut; we are called upon to say, that it is impossible for medical evidence to establish whether the child had lived or not, and therefore we are to decline making an inspection of its body. But this would be the same as declaring that child-murder could never be proved against an accused party, and that new-born children might henceforth be destroyed with impunity. It appears to me, that conduct of this kind, on the part of a medical witness, would be wholly unwarrantable; for we may sometimes acquire, by an inspection, as great a certainty of respiration having been performed, and therefore of a child having lived, as of any other fact of a medico-legal nature. Cases of poisoning often give rise to greater difficulties to a medical jurist; as where, for example, he attempts to found his opinion of the cause of death on symptoms or post-mortem appearances. But we will put the question in this light. In the body of a healthy full-grown child, which has but recently died, we find the lungs filling out the cavity of the chest, of a light-red colour, spongy, and crepitant beneath the finger, weighing at least two ounces, and, when divided into numerous pieces, each piece floating on water, even after violent compression? Is it possible in such a case to doubt that respiration has been performed? If there be no certainty here, it appears to me that medical experience is but little fitted in any case to guide us in our inquiries. It would be difficult to point out an instance in which an affirmative medical opinion would be more surely warranted by the data upon which it was founded.

It has been already stated that the pulmonary tests are only fitted to prove whether or not the child has lived to respire. Neither the hydrostatic nor any other test can positively show that the child was entirely born alive when the act of respiration was performed. As this is a subject which generally gives rise to some discussion in cases of child-murder, I shall here make a few remarks on it:—1st, Respiration may be performed while the child is in the uterus, after the rupture of the membranes;—the mouth of the child being at the os uteri. This is what is termed vagitus uterinus; its occurrence, although extremely rare, seems to me, to rest upon undisputed authority. 2ndly, A child may breathe while its head is in the vagina, either during a presentation of the head or the breech. This has been termed vagitus vaginalis. It is not very common, but it must be set down as a possible occurrence. 3dly, A child may breathe while its head is protruding from the outlet; in this position, respiration may be as completely set up in a few moments, by its crying, as we find it in some children that have actually been born, and have survived their birth for several hours. This is the most usual form of respiration before birth. In the vagitus uterinus or vaginalis, the lungs receive but a very small quantity of air; in respiration after protrusion of the head, the lungs may be sometimes found moderately well filled; although never, perhaps, possessing all the characteristic properties of those which have fully respired. The well-known occurrence of respiration, under either of these three conditions, strikingly displays the fallacy of making that process, as some have done, the certain criterion of extra-uterine life. A child may breathe in the uterus or vagina, or with its head at the outlet, and die before its body is born; the discovery of its having respired would not, therefore, be any sort of proof of its having enjoyed what has been termed "extra-uterine life." The death of a child which has respired in the uterus or vagina from natural causes, before its entire birth, is a possible occurrence; but its death from natural causes before birth, after it has breathed by the protrusion of its head from the outlet, is, I believe, a very unusual event. All that we can say is—it may take place; but its death, under these circumstances, would be the exception to a very general rule. Oberkamp, in four successive deliveries of the same female, observed that the children breathed before delivery, but died before they were born. A case of this kind also occurred to Diemerbroek. (See Meckel. Lehrbuch der G. M. p. 367; Beck's Med. Jur. 277; also, Ed. Med. and Surg. Jour. xxvi. 374.) The cases reported in Beck, of which there are three, lose much of their value from the fact that the lungs were not examined.

The hydrostatic test is only capable of determining that respiration has taken place: it cannot show whether that process was established during birth, or afterwards. The fact of a child having the power of breathing before it is entirely born, does not therefore constitute the smallest objection to its employment; although, upon this ground, we find the use of it, in any case, denounced by many eminent men of the medical and legal professions. Thus, Archbold says, "Very little confidence is placed in this test as to the lungs floating, particularly if the child were dead any length of time before the experiment was made." (Criminal Pleading, 367.) Matthews speaks of the test as being "quite exploded." (Digest, 251.) And Jervis makes the same remark. (On coroners, 127.) It is obvious that most members of the law who have treated this subject, have adopted, without sufficient examination, the statements of Dr. William Hunter. This author observes: "A child will commonly breathe as soon as its mouth is born or protruded from the mother; and. in that case, may lose its life before its body be born, especially when there happens to be a considerable interval between what we may call the birth of the child's head and the protrusion of its body. And if this may happen where the best assistance is at hand, it is still more likely to happen when there is none—that is, where the woman is delivered by herself." (On the uncertainty of the Signs of Murder in the case of Bastard Children, p. 33.) Dr. Hunter here exposes, in plain language, the fallacy of trusting to signs of respiration alone, as evidence of a child having been *born* alive. The truth of his remarks is, in the present day, generally admitted; and if, among medico-legal writers, we find some still treating of respiration as a certain proof of live birth, it is from their not having sufficiently considered the probability of a child breathing and dying before its body is entirely extruded. But we may ask, How does the admission of these views affect a case of deliberate child-murder? A living and breathing child may be wilfully destroyed before its body is entirely born, as well as afterwards; and if the law of England does not contemplate the wilful destruction of a living and breathing child, before its entire birth, as a crime, this omission cannot be imputed as a fault to the medical jurist; nor can it at all diminish the real value of the hydrostatic test, as furnishing indisputable evidence of life. Most persons might consider the crime of murder sufficiently made out, when the medical evidence showed that the child had lived, and that it was *living* when *criminally destroyed.* If, however, this do not constitute infanticide in law; and evidence be further insisted on, to set forth where the child was actually living when murdered—whether half protruding from the vagina, or altogether external to the body of the mother; then is the fact of a child respiring before birth, an objection rather against the principles of the law, than against the tests used to determine the presence of life. In a case tried a few years since, in which a child had been found with a ligature firmly tied around its neck, the medical evidence showed clearly, that it had breathed; and the whole of the appearances in its body, were such as to leave no medical doubt that it had died by strangulation. The judge, in charging the jury, said, "if they were of opinion that the prisoner had strangled her child before it was wholly born, she must be acquitted of the murder!" The prisoner was acquitted. However we may regard the question of the utility of pulmonary tests, we cannot but look upon that law, as but very imperfectly adapted to its purposes, which makes the proof of murder to rest, not upon the actual and wilful destruction of a living child, but upon the precise moment which a murderer may select for the accomplishment of the crime. Impunity is thus held out to all offenders, who destroy living children in the act of birth; but there is an additional evil, accompanying the operation of this legal rule, which seriously affects the medical evidence, given on these occasions. It would seem from cases to be presently related, that the law will assume, until the contrary appear from other circumstances, that the respiration of a child, if proved by the best of evidence, was carried on before it was entirely born. Let the witness, then, in a case of alleged infanticide, ever so clearly establish the fact of respiration, and therefore of life, at the time the violence was used, this evidence is not sufficient. He is asked whether he will depose that the child had breathed after its body was entirely in the world. Unless he can make this deposition—which, for obvious reasons, he cannot be in a condition to do—it will be presumed that, although the child had breathed, it came into the world dead. In this way, we perceive, a shield is effectually thrown around those who may have been really guilty of destroying their children immediately after birth. Under any moral consideration of the circumstances I think it impossible to admit, that a woman who kills her child in the act of birth is less guilty of murder than she who chooses the moment of its entire expulsion to destroy it;—any such distinction carried to its full extent, must virtually go to the entire abrogation of the law. It is quite necessary that medical witnesses should know what they are required to prove on these occasions; and the following cases will, perhaps, serve to place this matter in a clear light.

In the case of Rex v. Poulton, good medical evidence was given to show that the child was living, when the violence was offered to it. Of three medical witnesses, who were called, the first said in answer to questions put to him: It frequently happens that the child is born as far as the head is concerned, *and breathes*, but death takes place before the whole delivery is complete. My opinion in this case is, that the child had breathed, but I cannot take upon myself to say, that it was wholly born alive. The second said, that death might have occurred when the child was partly born, if no medical man was present to assist in the delivery. The third witness said, It is impossible to state when the child respired; but there is no doubt from the condition of the lungs, when they were examined, that they had breathed; children may breathe during the birth. (Chitty, Med. Jur. 412.) The evidence here given, shows that the witnesses were intelligent men; and that they had duly reflected upon what the hydrostatic test is really capable of proving. The judge held that this medical evidence was not sufficient:—"something more was required than to show that a child had respired in the progress of its birth; it must be proved that the whole body of the child was brought into the world. (See Matthew's Digest, Supp. 25; also, Archbold, Crim. Plea. 367.) In the case of Rex v. Simpson, tried at Winchester, in March 1835, Baron Gurney would not allow the case to proceed against a prisoner so soon as the medical witness stated that the lungs of a child might become distended by the act of respiration during birth. In Rex v. Brain, it was held, that a child must be wholly in the world in a living state to be the subject of murder; and in that of Rex v. Sellis (Norfolk Spring Circuit, 1837) Mr. Justice Coltman held, that to justify a conviction for child-murder, the jury must be satisfied that the entire body of the child was actually in the world in a living state, when the violence was offered to it.

But Mr. Baron Parke has pronounced a more decided opinion on this point, than any of the other judges. In relation to an important case of infanticide, tried at the Herts Lent Assizes, 1841, (See Guy's Hospital Reports, April 1842,) he thus charged the grand jury: "With respect to all these cases (of infanticide,) there is a degree of doubt whether the infant has been *born* alive. The law requires that this should be *clearly proved*, and that the whole body of the child should have come from the body of the parent. If it should appear that death was caused *during delivery*, then you will not find a true bill!"

From these decisions it will be seen, that it is not sufficient for a medical witness to declare, from the state of the lungs, that the child was alive at or about the time of its birth; according to the present views of our judges, it is indispensably necessary for him to prove that the child was *born* alive, or that it was living after its body had *entirely* come into the world.

CHAPTER XLVI.

ON THE PROOFS OF A CHILD HAVING BEEN BORN ALIVE.

1. Evidence from respiration.—There will, in general, be no difference in the state of the lungs, whether the act of respiration be performed by the child during parturition or after it is born. But should we find that this process has been completely established, i. e. that the lungs present all those conditions which have been described as characteristic of full and perfect respiration, there is great reason to presume, that the process, even if it commenced during birth, must have continued after the child was entirely born. This presumption becomes still stronger, when the child is immature; for generally speaking, such children must be born and continue to respire for many hours after birth, in order that their lungs should present the characters of complete respiration. The process is seldom so established before birth, as to give to these organs the feeling of crepitation under pressure; the existence of this character should, therefore, be sought for. A witness who relied upon it as a conclusive proof of respiration *after* birth, might be asked by counsel, whether it were not possible for some children to remain so long at the outlet with the head protruding, as to render the lungs crepitant from frequent respiration *before* birth. Admitting the possibility of this occurrence, he should endeavour to ascertain, whether there were any probable causes thus to protract delivery, while the head of the child was in this position; as also what natural cause could have produced its death when its head was protruding, and respiration so freely performed as to give crepitation to the lungs.

2. Evidence from marks of violence.—If marks of violence apparently inflicted about the same time, be found on different and distinct parts of the body, and these marks bear the characters of those produced during life, (antè, p. 286,) it is rendered probable that the whole of the body of the child was in the world, when they were caused. Marks of severe violence on one part, as the head or breech, would not justify such a presumption, because it may be fairly objected that they might have been unintentionally produced by the woman in her attempts at self-delivery, and yet the child not have been born alive. It would be for a witness to form an opinion whether they had been thus occasioned, from the circumstances accompanying the particular case. From this, it will be seen, that in making a post-mortem examination, it is proper that every mark of injury on the body of a child should be noted down.

3. Evidence from certain changes in the body.—In a child which has been born alive or which has survived its birth, that portion

of the umbilical cord which is contiguous to the abdomen, undergoes certain changes:—thus it becomes slowly corrugated and separates with or without cicatrization. The umbilical vessels become, at the same time, contracted. It has also been observed that the ductus arteriosus is contracted either in the centre or at its aortal termination;—and that the foramen ovale in the septum of the auricles becomes closed. There is no doubt that these changes, when they exist, clearly prove that a child has survived its birth, whatever may be the results of experiments on the lungs; but the difficulty is, that they require some days for their development, and in practice, it is necessary to procure some sign of a survivorship of only a few minutes, or at farthest of a few hours. The same remark applies to the exfoliation of the cuticle in a new-born child: such a condition of the skin can very rarely be found in cases of infanticide. The absence of meconium from the intestines, and of urine from the bladder, are not proofs of live birth, for these may be discharged during birth, and yet the child not be born alive. Perhaps better evidence may be derived from the discovery of certain liquids or solids in the stomach and intestines, such as blood, milk, or other articles of food; for it is not likely that these would be introduced or swallowed during parturition, nor is it at all probable that they should find their way into the stomach or intestines of a child which was really born dead. Dr. Geoghegan informed me of the case of a new-born child, in which he discovered, by the application of iodine water, the presence of farinaceous food in the stomach, whereby the question of live birth was clearly settled in the affirmative. An instance is related by Dr. Döring, where a spoonful of coagulated blood was found in the stomach of a new-born child. The inner surface of the œsophagus and trachea was also covered with blood. Dr. Döring inferred from these facts, that the child had been born alive; for the blood, in his opinion, must have entered the stomach by swallowing, after the birth of the child, and while it was probably lying with its face in a pool of blood.

The slightest consideration will show that the signs of live birth as above described, are weak, unsatisfactory, and of purely incidental occurrence. If the child be destroyed during birth or within a few minutes afterwards, there will be no medical evidence to show at which period its destruction took place. The external and internal appearances presented by the body would be the same in the two cases. It is most probable that in the greater number of instances of child-murder, the child is actually destroyed during birth, or immediately afterwards; and, therefore, the characters above described can rarely be available in practice. If any exception be made, it is with respect to the nature, situation and extent of marks of violence; but the presence of these depends on mere accident. Hence, then, we come to the conclusion, that although medical evidence can often show from the state of the lungs, that a child has really lived, it can very rarely be in a condition to prove in a case of infanticide, that its life certainly continued after its birth. Why the destruction of a child should be treated in the one case as a venial offence, and in the other as a capital crime, is one of those anomalies in our criminal jurisprudence for which it is impossible to account. The inference which we may draw from these observations is, that if positive proof of entire live birth, be in all cases rigorously demanded of medical witnesses on trials for child-murder, it is quite impossible, where the prisoner is ably defended, that any conviction for the crime should ever take place. The only exceptions would be, where a confession was made by the accused, or the murder was perpetrated before eye-witnesses. The numerous acquittals that take place on trials for this crime, in face of the strongest medical evidence, bear out the correctness of this opinion.

CHAPTER XLVII.

HOW LONG DID THE CHILD SURVIVE ITS BIRTH? HOW LONG HAS IT BEEN DEAD?

If we suppose it to have been clearly established, that the child not only lived but was actually born alive, it may be a question whether it lived for a certain number of hours or days after it was born. The answer to this question may be necessary in order to connect the deceased child with the supposed mother. It has been remarked that scarcely any appreciable changes take place in the body of a child, until after the lapse of twenty-four hours; and these changes may be considerably affected by its degree of maturity, healthiness and vigour.

1. After twenty-four hours.—The skin is firm and pale, or less red than soon after birth. The umbilical cord becomes somewhat shrivelled, although it remains soft and bluish coloured from the point where it is secured by a ligature, to its insertion in the skin of the abdomen. The meconium is discharged; but a green-coloured mucus is found on the surface of the large intestines. The lungs will be more or less distended with air, although in a case of survivorship for a period longer than this, no trace of air was found in them. With regard to the state of the lungs, it should be remembered, that when these organs are fully and perfectly distended, the inference is that the child has probably survived many hours; but the converse of this proposition is not always true. Many cases already reported, show that where the lungs contain a very small quantity of air, it does not follow that the child must have died immediately after it was born, (antè, p. 456.)

2. From the second to the third day.—The skin has a yellowish tinge,—the epidermis sometimes appears cracked, a change

which precedes exfoliation. (Devergie, i. 519.) The umbilical cord becomes brown and dry between the ligature and the abdomen.

3. From the third to the fourth day.—The skin is more yellow, and there is evident exfoliation of the cuticle on the chest and abdomen. The umbilical cord is of a brownish red colour, flattened, semi-transparent and twisted. The skin in contact with the dried portion presents a ring of vascularity or redness;—but Dr. Geoghegan met with this appearance in two cases of still-born children, and I have also seen it in four cases where the children were born dead. (G. H. Rep. April 1842.) The colon is free from any traces of green mucosity.

4. From the fourth to the sixth day.—The cuticle in various parts of the body is found separating in the form of minute scales or of a fine powder. The umbilical cord separates from the abdomen usually about the fifth day, but sometimes not until the eighth or the tenth. The membranous coverings become first detached, then the arteries, and afterwards the vein. The ductus arteriosus may be found contracted both in length and diameter:—the foramen ovale may be also partly closed. The changes which take place in the ductus arteriosus and foramen ovale, have been especially observed by Bernt of Vienna. According to him, if a child respire only for a few seconds, the duct becomes contracted at one of its extremities, commonly at the aortal end:—although this is perhaps generally true, yet cases have fallen under my observation, where there was no perceptible change in the diameter of the duct, and yet the children had respired for some time after birth. In instances of feeble respiration, such a change can hardly be looked for. The same remarks will apply to the contraction of the foramen ovale.

5. From the sixth to the twelfth day.—The cuticle will be found desquamating on the extremities. If the umbilical cord was small, cicatrization will have taken place before the tenth day after birth. If large, a sero-purulent discharge will sometimes continue for twenty-five or thirty days. The ductus arteriosus is said to become entirely closed during this period; but it has been found pervious many years after birth, and it is probable that in many subjects some months elapse before it is entirely obliterated. The fact of its being found pervious, can therefore furnish no certain evidence. The closure of the foramen ovale is equally uncertain, as to the time of its occurrence. According to Billard it becomes closed in the greater number of instances between the second and third days: but there are numerous cases in which the closure does not take place. Dr. Handyside states that it is open in one case out of eight. In 1838, two subjects were examined at Guy's Hospital, one aged fifty, the other eleven years, and in both the foramen ovale was found open. We may say of this aperture, as of the arterial duct,—when contracted or closed, it furnishes certain evidence of a child having survived birth, for how long a period above two or three days it is impossible to say:—but when found unclosed, as it probably would be in the generality of

cases of infanticide, it is susceptible of furnishing no evidence whatever.

On the whole, it will be seen that the signs of survivorship for short periods after birth are not very distinct. The changes stated to take place during the first twenty-four hours in the umbilical cord, may be observed in the dead as well as in the living child; and the other changes occur with much uncertainty as to the period. These are, however, I believe the principal facts upon which a medical opinion on such a subject can be based, and it is in some respects fortunate, that great precision in assigning the time of survivorship, is not demanded of medical witnesses.

A practitioner may be further required to state, *how long a period has elapsed since the death of the child.* The answer to the previous question, was derived from the changes which take place in the body of a child during life, while in relation to the present inquiry, we must look to those which occur in the body after death:—in other words, to the different stages of putrefaction. From the observations of Orfila, it would appear that the body of an infant putrefies more rapidly than that of an adult. (Traitè des Exhumations.) In forming a judgment on this point, due allowance must be made for the influence of temperature and humidity. If the body has been sunk in water, putrefaction takes place more slowly than usual, and the process is slower in running than in stagnant water. When the body is floating on the surface of water, so as to be at the same time exposed to air, then putrefaction takes place very rapidly:—and this also happens, when the body, after removal from water, has been allowed to remain for some time exposed to air. Putrefaction is also retarded when the deceased child has been buried in the ground in a box or coffin, unless the process had already commenced prior to interment. When the body has been cut up and mangled before being thus disposed of, putrefaction takes place with much greater rapidity.

CHAPTER XLVIII.

DEATH OF THE CHILD FROM NATURAL CAUSES.

The next important question in a case of infanticide, and that upon which the charge of murder essentially rests is,—what was the cause of death? 1. It is admitted that a child may die during birth or afterwards. 2. In either of these cases it may die from natural or violent causes. 3. The violent causes may have originated in accident or in criminal design. The last case only involves the corpus delicti of child-murder. If death has clearly proceeded from natural causes, it is of no importance to settle whether the cause operated during or after birth:—all charge of criminality is thenceforth at an end.

It is well known that of children which are born under usual circumstances, a great number die from natural causes either during birth or afterwards: and in every case of infanticide, death will be presumed to have arisen from some cause of this kind, until the contrary appear from the evidence. This throws the onus of proof entirely on the prosecution. Many children die before performing the act of respiration; and thus a large number come into the world still-born, or dead. The proportion of still-born among legitimate children, as it is derived from statistical tables extending over a series of years and embracing not less than eight millions of births, varies from one in eighteen to one in twenty. (B. and F. Med. Rev. No. vii. 234.) Dr. Lever found out of three thousand births, that one in eighteen was born dead. In immature and illegitimate children the proportion is much greater, probably about one in eight or ten. In Göttingen they were found to amount to one in seven, and in Berlin, to one in ten. (Ed. Med. and Surg. Journ. xxvi. 172.) Males are more frequently born dead than females. These facts should be borne in mind, when we are estimating the probability of the cause of death being natural. When respiration is established by the protrusion of the child's head or the birth of its body, the chances of death from natural causes are considerably diminished. Nevertheless, as Dr. Hunter long ago suggested, a child may breathe and die. Thus, according to this author:—" If the child makes but one gasp and instantly dies, the lungs will swim in water, as readily as if it had breathed longer and had then been strangled." In general, it would require more than one gasp to cause the lungs to swim readily in water; but granting this point, the real question is,—if this child breathed after birth, what could have caused its death? The number of gasps which a child may make, or which may be required for the lungs to swim in water, is of no moment:—the point to consider is, whether its death was due to causes of an accidental or criminal nature. So again observes Dr. Hunter, " We frequently see children born, who from circumstances in their constitution or in the nature of the labour, are but barely alive, and after breathing a minute or two or an hour or two, die in spite of all our attention. And why may not this misfortune happen to a woman who is brought to bed by herself?" (Op. Cit.) The substance of this remark is, that many children may die naturally after birth; and in Dr. Hunter's time, these cases were not perhaps sufficiently attended to. In the present day, however, the case is different:—a charge of child-murder is seldom raised unless there be the most obvious marks of severe and mortal injuries on the body of a child; and unless the practice of infanticide be defended and justified, it must be admitted that the discovery of violence of this kind on the body of an infant renders a full inquiry into the circumstances necessary. Among the [natural causes of the death of a child, may be enumerated the following,

1. A PROTRACTED DELIVERY.—The death of a child may proceed in this case from injury suffered by the head during the violent

contractions of the uterus, or from an interruption to the circulation in the umbilical cord before respiration is established. A child, especially if feeble and delicate, may die from exhaustion under these circumstances. This cause of death may be suspected, when a sero-sanguinolent tumour is found on the head of a child, and the head itself is deformed or elongated :—internally by the congested state of the cerebral vessels. The existence of deformity in the pelvis of the woman might corroborate this view; but in primiparous females (among whom charges of child-murder chiefly lie,) with well-formed pelves, delivery is frequently protracted. It is presumed that there are no marks of violence on the body of the child, other than those which may have arisen accidentally in attempts at self-delivery.

2. Debility.—A child may be born prematurely or at the full period, and not survive its birth owing to a natural feebleness of system. This is especially observed with immature children ; and it is the condition more particularly dwelt on by Dr. Hunter. Such children may continue in existence for several hours, feebly respiring, and then die from mere weakness. These cases may be recognized by the appearance of a general want of development in the body.

3. Hæmorrhage.—A child may die from hæmorrhage, owing to a premature separation of the placenta or an accidental rupture of the umbilical cord. In the latter case, it is said the loss of blood is not likely to prove fatal, if respiration have been established, but an instance is reported where a child died from hæmorrhage even under these circumstances. (Henke's Zeitschrift Erg. 1839, 200 : also 1840, i. 347 and ii. 105.) Death from hæmorrhage may be commonly recognized by the blanched appearance of the body, and a want of blood in the internal organs. It was formerly a debated question whether in the event of the umbilical cord being left untied after cutting or laceration, such a degree of hæmorrhage could occur as would prove fatal to a child. The case just referred to, renders it unnecessary to discuss that question. Hæmorrhage is more likely to prove fatal, when the cord is divided by a sharp instrument, than when it is lacerated; and its dangerous effects on the child are great in proportion as the division is made near to the umbilicus. It has been improperly described as a case of infanticide by omission, where a self-delivered woman neglects to apply a ligature to the cord under these circumstances ; because it is said she ought to know the necessity for this in order to prevent the child dying from hæmorrhage. Such a doctrine assumes not only malice against the accused, but that in the midst of her distress and pain she must necessarily possess the knowledge and bodily capacity of an accoucheur, a doctrine wholly repugnant to the common feelings of humanity.

This question was actually raised in the case of the Queen v. Dash, Aug. 1842. There was no doubt that the child had breathed, and that its death had been caused by hæmorrhage from the lacerated umbilical cord. The medical witness properly admitted, that the cord might have been torn through by the weight of the child during labour, and the jury acquitted the prisoner on the ground that she might have been ignorant of the necessity or not have had the power to tie the cord.

4. Compression of the cord.—When a child is born by the feet or buttocks, the cord may be so compressed under strong uterine contraction, that the circulation between the mother and child will be arrested, and the latter will die. The same fatal compression may follow, when during delivery the cord becomes twisted round the neck. A child has been known to die under these circumstances before parturition, the cord having become twisted round its neck in utero. (Med. Gaz. Oct. 1840, 122.) Other cases of death from this cause, during delivery, will be found in the same journal. (Vol. xix. 232, 933.) On these occasions, the child is sometimes described to have died from strangulation; but it is evident that before the establishment of respiration, such a form of expression is improper. The child dies simply from arrested circulation. The body may present few or no appearances indicative of the cause of death. There may be lividity about the head and face, and cerebral congestion internally; but it is proper to state, that the brain of a child is always more congested than that of an adult.

5. Malformation.—There may be a deficiency of some vital organ, which would at once account for the child dying either during delivery or soon after its birth. Two cases are reported, in one of which the child died from an absolute deficiency of the œsophagus,—the pharynx terminating in a cul-de-sac; and in the other, the duodenum was obliterated for more than an inch, and had occasioned the child's death. (Med. Gaz. xxvi. 542.) There can be no difficulty in determining whether the malformation be such as to account for death. Individuals are not allowed to destroy these monstrous births; and the presence of marks of violence in such cases, should be regarded with suspicion.

6. Congenital disease.—It has been elsewhere stated, that a child may be born labouring under such a degree of congenital disease, as to render it incapable of living (antè, p. 454.) The discovery of any of the fœtal organs merely in a morbid condition, amounts to nothing, unless the disease has advanced to that degree to account for death. There are, doubtless, many obscure affections, particularly in the brain, which are liable to destroy the life of a child without leaving any well-marked post-mortem changes. According to Dr. Burgess, apoplexy and asphyxia are very common causes of death among new-born children. (Med. Gaz. xxvi. 492.) Probably diseases of the lungs are of the most importance in a medico-legal view; because by directly affecting the organs of respiration, they render it impossible for a child to live, or to survive its birth for a long period. These diseases are principally congestion, hepatization, tubercles, scirrhus and œdema,—the existence of any of which, it is not difficult to discover. They render the structure of the lungs heavier than water; and thus prevent the organs from acquiring that buoyancy which in their healthy state they are known to have. (See antè, p. 454.) It is not common to find the lungs diseased throughout:—a portion may be sufficiently healthy to allow of a partial performance of re-

spiration. The lungs may not be found diseased ; but simply in that condition which has been elsewhere described under the name of atelectasis, (antè, p. 455.) The causes upon which this condition of the lungs depends are not well understood. The non-establishment of respiration sometimes arises from the circumstance, that the mouth and fauces of the child are filled with mucus.

CHAPTER XLIX.

DEATH OF THE CHILD FROM VIOLENT CAUSES. WHETHER THE VIOLENCE WAS OF ACCIDENTAL OR CRIMINAL ORIGIN.

We shall here have to consider all those modes of death which are totally independent of the existence of congenital disease, or other natural causes. There are certain forms of child-murder which are not necessarily attended with any appearance indicative of violence,—these are suffocation, drowning, exposure to cold,—and starvation.

1. Suffocation.—This is a very common cause of death in new-born children. Wet cloths may be placed over the child's mouth, or thrust into that cavity during birth or afterwards, and before or after the performance of respiration. To the latter case only, could the term suffocation be strictly applied. A child may be thus destroyed by being allowed to remain closely compressed under the bed-clothes after delivery, or by its head being thrust into straw, feathers and such like substances. The post-mortem appearances are seldom sufficient to excite a suspicion of the cause of death unless undue violence have been employed. There is commonly merely lividity about the head and face, and slight congestion in the lungs. A careful examination of the mouth and fauces should be made, as foreign substances are sometimes found in this situation, affording circumstantial evidence of the mode in which the suffocation has taken place. Thus wool, straw, feathers, dust or a hard plug of linen, may be, and in some cases have been found blocking up the mouth and fauces. Again, a child may be suffocated by having its head held over mephitic vapour, as in the exhalations of a privy or burning sulphur. There are few of these cases in which a medical opinion of the cause of death could be given, unless some circumstantial evidence were produced and the witnesswere allowed to say, whether the alleged facts were sufficient to account for death.

On the other hand, if it be even clearly proved that death has been caused by suffocation, it must be remembered that a child may be accidentally suffocated, and the crime of murder falsely imputed. Dr. Hunter being well aware of the risk to which a female might be thus exposed, observes in relation to this point,—" When a woman is delivered by herself, a strong child may be born perfectly alive, and die in a very few minutes for want of breath, either by being on its face in a pool formed by the natural discharges, or upon wet clothes;—or by the wet things over it collapsing and excluding air, or drawn close to its mouth and nose by the suction of breathing. An unhappy woman delivered by herself, distracted in her mind and exhausted in her body, will not have strength or recollection enough to fly instantly to the relief of her child." (Op. cit. 35.) It may be added that a primiparous female may faint or become wholly unconscious of her situation; or if conscious, she may be ignorant of the necessity of removing the child, and thus it may be suffocated without her having been intentionally accessary to its death. In such cases, however, there should be no marks of violence on the body, or they should be of such a nature and in such a situation, as to be readily explicable on the supposition of an accidental origin. A young infant is very easily destroyed by suffocation. If the mouth and nostrils be kept covered for a very few minutes, as by its being closely wrapped in clothes, asphyxia may come on without this being indicated by convulsions or any other marked symptoms. Suspicion of murder may arise in such cases; but the absence of marks of violence, with an explanation of the circumstances, will rarely allow the case to be carried beyond an inquest. Sometimes the body is found maltreated, with marks of strangulation about it,—concealed in a feather-bed or privy;—or cut up and burnt. This kind of violence may properly excite a suspicion of murder, and lead to the belief that the allegation of death from accidental suffocation was a mere pretence. This, however, is purely a question for the jury and not for a witness. Unless the case be of a very glaring nature, the violence is considered to have been employed for the purpose, rather of concealing the birth of the child than of destroying it. In the present day, these cases of death from accidental suffocation, when properly investigated, can never implicate an innocent woman in a charge of murder; although the facts may show in many instances that the death of the child was really due to great imprudence, neglect or indifference.

The following case, (the Queen v. Mortiboys,) tried at the Summer Assizes, in 1841, will show that even when the evidence is very strong against a person, the circumstances will be favourably interpreted. In this instance, it was proved that the body of the child was discovered in a box containing wool:—it was lying on its abdomen with its face raised and the mouth open. A red worsted comforter had been passed twice round the neck, and was tied the second time in a single knot over the chin. In the mouth, which was open, was found a small quantity of fine flocks of wool. The medical evidence showed that the child had been born alive, the left lung being fully inflated. The brain was congested. There was no mark produced by the ligature on the neck, either externally or internally. Death was referred to obstructed respiration, (suffocation,) caused partly by the ligature and partly by the wool in the mouth,—but the latter was considered to be the more active cause of death. In the defence, it was urged that the ligature could not have produced strangulation, because the comforter was tied upon the chin,

—that the medical evidence showed the wool in the mouth to have been the more active cause of death,—this was probably taken into the mouth by the child itself in the instinctive action of breathing, and not put there by the prisoner for the purpose of suffocation. The child had probably been placed carelessly on a quantity of wool, into which it had sunk by its own weight, and this had caused its death. The judge is reported to have joined in this view, and in charging the jury, to have said, that had the prisoner intended to choke the child with the wool, she would have inserted enough to fill its mouth. The prisoner was acquitted.

In this case, admitting that the evidence did not bear out the charge of murder, still it is pretty clear that death was caused by the child being placed on its face in a close box filled with wool and with a ligature round the neck. There appears here, admitting the facts to have been as represented, something more than accident: for the prisoner must have known that a new-born infant was not likely to live under such circumstances, and had it been a week or a month old she would probably have been convicted of manslaughter or murder.

2. Drowning.—The fact of drowning cannot be verified by any appearances on the body of a child which has not breathed. Thus, if a woman caused herself to be delivered in a bath, and the child were forcibly retained under water, (a case which is said to have occurred,) it would of course die; but no evidence of the mode of death would be found on the body. After respiration the signs of drowning will be the same as those met with in the adult. (See pòst, Drowning.) The main question for a witness to decide, will be whether the child was put into the water living or dead. Infanticide by drowning is by no means common:—the child is generally suffocated, strangled, or destroyed in other ways, and its body is then thrown into water, in order to conceal the real manner of its death. The finding of the dead body of an infant in water, must not allow the witness to be thrown off his guard;—although a verdict of "found drowned," is so commonly returned in these cases. The body should be carefully inspected, in order to determine what was really the cause of death. All marks of violence on the bodies of children that have died by drowning, should be such as to have resulted from accidental causes. It is not necessary, that the whole of the body should be submerged in order that a child should be destroyed by drowning. The mere immersion of the head in water, will suffice to produce all the usual effects. A case occurred in London, in 1842, where a woman attempted to destroy her child by immersing its head only, in a bucket of water. The child was discovered and resuscitated.

New-born children are very often drowned or suffocated by being thrown into the soil of a privy. Sometimes the child is destroyed in other ways, and its body is thus disposed of for the purposes of concealment. Should there be a large quantity of liquid present, the phenomena are those of drowning. This liquid abounding in hydrosulphuret of ammonia, may then be found, if the child were thrown in living, in the air-passages and the stomach. On these occasions, the defence may be, 1, that the child was born dead, and that the body was thrown in for concealment; but the medical evidence may show that the child had breathed and had probably been born living. 2. It may be alleged that the child breathed for a few moments after birth, but then died, and that the female thus attempted to conceal the body. A medical witness may be here asked, whether a woman could have had power to convey the body to this place,—a point which must in general be conceded. 3. It is most commonly urged, that the woman being compelled to go to the privy, was there delivered unconsciously, and that the child dropped from her and was suffocated. All these circumstances may readily occur, but the explanation may be sometimes inconsistent with medical facts. Thus the head or the limbs of the child may be found to have been separated or divided by some cutting instrument,—or a cord or other ligature may be found tightly bound around its neck. Then again the body may be entire, but the umbilical cord may be found cleanly cut. This would tend to set aside the explanation of the child having accidentally dropped from her; because in such a case, the cord should be found ruptured.

Whether in any instance, the drowning of a child was accidental or criminal, must be a question for the jury to determine from all the facts laid before them. The situation in which the body of an infant is found, may plainly contradict the supposition of accident. On the other hand, a child may be accidentally drowned by its mouth falling into a pool of the discharges during delivery, although this would be rather a case of suffocation.

3. Cold.—A new-born child may be easily destroyed by simply exposing it uncovered or but slightly covered in a cold atmosphere. In a case of this kind, there may be no marks of violence on the body, or they may be slight and evidently of accidental origin. In death from cold, the only appearance which has been occasionally met with, was congestion of the brain with or without serous effusion in the ventricles. (See pôst, Cold.) The evidence, in these cases, must be purely circumstantial. The medical witness may have to consider, how far the situation in which the body was found,—the kind of exposure and the temperature of the air, would suffice to account for death from the alleged cause. There is no doubt that a new-born child is easily affected by a low temperature, and that warm clothing is required for the preservation of its life. An inspection of the body should never be omitted on these occasions; because it may turn out, that there was some latent cause of death which would at once do away with the charge of murder. Admitting that the child died from cold, it becomes necessary to inquire whether the prisoner exposed it with the malicious intention that it should thus perish. Unless wilful malice be made out, the accused cannot be convicted of infanticide. In general, females do not expose their children for the purpose of destroying them, but for the purpose of abandoning them: hence it is rare to hear of convictions for child-murder, where cold was the cause of death, although some medical jurists have called this infanticide by omission, an offence which does not appear to be recognized by the English law.

In the case of the Queen v. Walters, (Oxford Aut. Assizes, 1841,) it was proved that the prisoner, while travelling in a waggon, had suddenly left it, and that she was delivered of a child, which was afterwards found dead and exposed on the road. There was no doubt that the child had been born alive; for it was heard to cry after it was abandoned by its mother, who appeared to have carried it some distance after it was born. The child had died from exposure to cold. The woman was convicted of manslaughter, and sentenced to ten years transportation. For other medico-legal cases of death from cold, see Henke's Zeitschrift 1836, also 1840. i. 168, Erg. h.

4. Starvation.—A new-born child kept long without food will die, and no evidence of the fact may be derivable from an examination of the body. There may be no marks of violence externally, nor any pathological changes internally, to account for death. This is a rare form of committing murder, unless as it may be accidentally combined with exposure to cold. In order to convict the mother, it is necessary to show that the child was wilfully kept without food, with the criminal design of destroying it. Mere neglect or imprudence, will not make the case infanticide. The only appearance likely to be found on an examination of the body would be complete emptiness of the alimentary canal. Without corroborative circumstantial evidence, this would not be sufficient to establish the cause of death. A medical witness could only form a probable conjecture on the point.

Among those cases of violent death, which leave on the body of the child, certain marks or appearances indicative of the cause, may be mentioned wounds, strangulation and poisoning.

5. Wounds.—Probably this is one of the most frequent causes of death in cases of infanticide. Wounds may, however, be found on the body of a child which has died from some other cause. The principal questions which a medical witness has to answer, are, 1, Whether the wounds were inflicted before or after death, or, to adopt the legal view of the matter, before or after the body of the child was entirely in the world in a living state: for according to the decisions of our judges, (antè, p. 441,) a child is not considered living in law, at least its destruction does not appear to be murder, until its body is entirely born. In most cases, it will be utterly impossible for a medical witness to return any answer to a question put in this form. All that medical evidence can pretend to show, is whether or not the child was living when the wounds were produced:—for whether the whole of its body was or was not in the world at this time, they will possess precisely the same characters. In a few cases only, a conjectural opinion may be formed from the nature, extent and situation of these injuries; 2, The witness will be required to state whether the wounds were inflicted before or after death; 3, whether they were sufficient to account for death; 4, whether they originated in accident or criminal design. All of these questions have been fully considered in treating the subject of Wounds; and they therefore do not require any further notice in this place.

A case of infanticide was tried at the Buckingham Summer Assizes, 1840, (the Queen v. Wood,) where the main question was, whether five severe wounds found on the head of the child, were inflicted before or after death and accidentally or criminally. The mother confessed, that the child was born alive, and had cried, but that it had died in five minutes after its birth. Its body was buried, and it was assumed that the wounds might have been inflicted after death by a spade which had been used for that purpose. The medical witness attributed death to the wounds, which, in his opinion, could not have been accidentally produced, but very properly admitted in cross-examination that the wounds would have presented the same appearances, had they been inflicted immediately after death, while the blood was in a fluid state.

Answers to questions of this kind, can of course be given only in those cases where the body is examined soon after the infliction of the wounds. It would be extremely hazardous to pronounce an opinion where the child had been long dead. In the case of the Queen v. Taylor, (York Lent Ass. 1843,) the child had been dead about a year, and when its body was found in a garret, it was so much dried up that the medical witnesses were unable, with certainty, to state the sex. The left arm had been removed from the body, and on the throat was a cut extending nearly from ear to ear, which was considered to have been made by some sharp instrument, and which, from the retraction of the edges of the wound, the witnesses thought must have been produced during life or immediately after death. The prisoner was acquitted. In this case there do not appear to have been any good medical reasons, for the opinion expressed as to the time at which the wound had been caused. Certainly, the retraction of the edges could furnish no evidence in a wound produced a year before, and in a subject so dried up as to render the recognition of the sex difficult. This may have been a case of child-murder, but there was no medical proof of it: it was not even proved that the child had come into the world living. Incised wounds found on the bodies of children may be referred to the use of a knife or scissors by the prisoner, in attempting to sever the cord, and therefore be due to accident. This point should not be forgotten, for a wound even of a severe kind might be thus accidentally inflicted. In such cases, we should always expect to find the cord cut and not lacerated. In the case of the Queen v. Wales, (Cent. Crim. Court, Sept. 1839,) it was proved that there was a wound on the right side of the neck of the child, not involving any important vessels, although it had caused death. The medical witness allowed, that it might have been accidentally inflicted in the way suggested, and the prisoner was acquitted. As this question may be unexpectedly put on a trial, a witness should prepare himself for it by a careful examination of the wound and of the umbilical cord. This will in general suffice to show, whether an incised wound has been produced accidentally in the manner alleged, or by criminal design.

Slight marks of external violence should not be overlooked :—minute punctures or incisions may correspond to deep-seated injury of vital organs. The spinal marrow is said to have been wounded by needles or stilettoes, introduced between the vertebræ, the skin being drawn down before the wound was inflicted, in order to give it a valvular character, and render it apparently superficial. The brain is also said to have been wounded by similar weapons, through the cribriform plate of the ethmoid bone or the fontanelles.

The only injuries which require to be specially considered in relation to infanticide, are fractures of the skull, and here the question to which we may restrict our examination, is whether the fracture arose from accident or criminal violence. Although it has been a matter of frequent observation, that great violence may be done to the head of a child during parturition without necessarily giving rise to fracture, yet it is placed beyond all doubt, that this injury may occur by the expulsive efforts of the uterus forcing the head of the child against the bones of the pelvis. Even the violent compression which the head sometimes experiences in passing the os uteri, may suffice for the production of fracture. (See Ed. M. and. S. J. xxvi. 75.) Until within the last few years, it had been generally supposed that fractures of the cranium in new-born children, were always indicative of violence; but the cases collected by Dr. Schwörer, of Freiburg, and others, establish the possibility of their accidental occurrence. These accidental fractures, it is to be observed, are generally slight ;—they commonly amount merely to fissures in the bones, beginning at the sutures and extending downwards for about an inch or less, into the body of the bone.

The following case occurred to Dr. Schwörer while performing his duties at the Obstetric Institution. The child was still-born; he received it into his hands at birth, so that the head could have sustained no outward violence. On inspection, the skin over the vertex was found swollen ; and on removing it, there was a large extravasation of blood beneath, especially over the right parietal bone. This bone was fractured or fissured in two places. Blood in a half coagulated state, was found beneath the fissures, between the bone and the dura mater, as also between this and the tunica arachnoides. (Beit. zur. Lehr. v. d. Kindermord. Freiburg, 1836.) Here then were all the signs indicative of external violence ; and possibly, had this woman been delivered in secret, and the body of the child found in a concealed place, she might have been charged with the murder. Another case is reported in Casper's Wochenschrift, (Oct. 1840,) where about half a drachm of blood was extravasated on the right parietal bone, which was compressed in the middle and presented a radiated fracture. Coagula were found on the dura mater. (See also B. and F. Med. Rev. xxi. 254, and vii. 233.) In another case, where there was deformity of the pelvis, the child was born dead, and there were two fissures about an inch long in the left parietal bone ; and both parietal bones were considerably flattened. (Casper's Wochenschrift, Sept. 1837.)

In respect to these accidental fractures and extravasations, it may be remarked that they are in general recognized by their very slight extent. In cases of murder by violence to the head, the injuries are commonly much more severe : the bones are driven in,—the brain protrudes, and the scalp is extensively lacerated. Such extensive injuries as these, cannot arise accidentally during parturition from the action of the uterus. In these cases, however, it may be fairly urged, that the woman was unexpectedly seized with labour, that the child was expelled suddenly by the violent efforts of the uterus, and that the injuries might have arisen from its head coming in contact with some hard surface, as a floor or pavement. It must be admitted, that a woman may be thus suddenly and unexpectedly delivered while in the erect posture, although this is not common among primiparous females ; and that injuries may be thus produced on the head of a child. If we are to judge from the cases collected by Dr. Klein, fractures of the cranium under these circumstances, must be of very rare occurrence. Out of one hundred and eighty-three cases reported by him, in which the women were rapidly delivered while sitting, standing, or inclined on the knees,—the child falling on the ground or floor, there was only one instance in which the child was killed; and there was not a single case in which the bones of the cranium were fissured or fractured, so far as could be ascertained by external examination. (Devergie, i. 631. Briand, 271.) Chaussier performed some experiments on the bodies of still-born children, allowing them to fall with their heads downwards on a paved floor from a height of eighteen inches; and he found that out of fifteen cases one or other of the parietal bones was fractured in twelve. Although these results are conflicting, yet Klein's observations appear more to the purpose; because they were made under circumstances in which the question would really arise in a case of infanticide. These observations would lead to the inference that such accidents are not likely to occur, yet we cannot deny the possibility of their occurrence; therefore a barrister is fully justified in endeavouring to exculpate a person charged with child-murder upon this ground. A medical witness would find no difficulty in determining the probability of this explanation of the origin of the fractures, if he were made acquainted with all the facts connected with the delivery. But the acquisition of this knowledge must be accidental; and it will in general be out of his power to obtain it. Sometimes the fractures will be accompanied by incisions, punctures, or lacerations of the scalp or face:—in this case, however the origin of the fractures might be accounted for by the alleged fall during parturition, the cause of the other injuries would still remain to be explained.—(See the case of the Queen v. Reeve, Cent. Crim. Court, Feb. 1839.)

The report of a very interesting trial, in which this question of the accidental origin of fractures arose, will be found in the Med. Gaz. xviii. 44. The case was tried before the Criminal Court of New York in November, 1834. One of the medical witnesses positively denied that the bones of the cranium could be fractured by the action of the uterus during parturition. It appeared highly probable that the fractures had here been occasioned by the accidental fall of the child during delivery—and the prisoner was acquitted.

It has been recommended on these occasions, that we should observe the length of the umbilical cord, and notice whether it be cut or lacerated, as these facts may, it is presumed, throw some light on the question. But a medical witness can seldom procure the cord for examination, although it will generally be in his power to ascertain whether it was cut or lacerated by examining that portion attached to the body of the child. The cord varies in length,—the average being from eighteen to twenty inches; but it has been met with so short as seven and a half inches, and in one instance, where it was found twice twisted round the child's neck, it was fifty-three inches long. Dr. Churchill found, out of three hundred and ninety-one cases, that the shortest cord was twelve inches, and the longest fifty-four inches in length. As the whole of the cord can rarely be obtained, it is unnecessary to discuss the question, whether it were long enough to admit of the falling of the child without rupture. It has been remarked that when the cord is ruptured from accidental causes during delivery, the rupture takes place either very near its placental or umbilical end. In twenty-one of the cases observed by Klein, it was found to have been forcibly torn out of the abdomen; but it may be torn or lacerated at any part of its length, although the rupture is commonly observed to occur near one or the other extremity. It does not easily appear how the examination of the cord can throw any light upon the origin of these fractures of the cranium.

Children are sometimes destroyed in the act of birth by the neck being forcibly twisted, whereby a displacement of the cervical vertebræ, with injury to the spinal marrow, may occur and destroy life. Such injuries are immediately discovered by an examination. It should be remembered that the neck of a child is short, and it possesses considerable mobility.

When the marks of violence found on the head, neck and body of a child, cannot be easily referred to an accidental fall, it is very common to ascribe them to the efforts made by the woman in her attempts at self-delivery, and without any intention on her part of destroying life. The rules to guide a medical opinion in such a case, must depend upon the nature, situation and extent of the injuries; and each case must be therefore decided by the circumstances attending it. (The Queen v. Horder, Abingdon Summer Ass. 1840.) This should be contrasted with another case (the Queen v. Trilloe, Hereford Summer Ass. 1842.) In both instances, the children were admitted to have been living;—in the former the violence was chiefly confined to the head, and the prisoner was acquitted,—in the latter the marks of violence were upon the neck, and the prisoner was convicted. These cases show the uncertainty attendant on a plea of this kind.—(See also two other instances B. and F. Med. Rev. viii. 521.)

CHAPTER L.

DEATH OF THE CHILD FROM VIOLENT CAUSES—WHETHER THE VIOLENCE WAS OF ACCIDENTAL OR CRIMINAL ORIGIN.

6. Strangulation.—The destruction of a new-born child by strangulation, is not an unfrequent form of child-murder; and here a medical jurist has to encounter the difficulty that the strangulation might have been accidentally produced by the twisting of the umbilical cord round the neck during delivery.

We must not hastily conclude from the red and swollen appearance of the face and head of a child, when found dead, that it has been destroyed by strangulation. There is no doubt that errors were formerly made with respect to this appearance; for Dr. Hunter observes, "When a child's head or face looks swollen, and is very red or black, the vulgar, because hanged people look so, are apt to conclude that it must have been strangled. But those who are in the practice of midwifery, know that there is nothing more common in natural births, and that the swelling and deep colour go gradually off if the child live but a few days. This appearance is particularly observable in those cases, where the navel-string happens to gird the child's neck, and where its head happens to be born some time before its body."—(Op. cit. 27.)

Strangulation by the cord can of course only refer to those cases where the cord becomes firmly twisted round the neck after the respiratory process is established; and this is rather a rare occurrence,—as death more usually takes place by compression of the cord under these circumstances, and the consequent arrest of circulation before the act of breathing is performed. (See antè, p. 480.) The appearance of ecchymosis on the scalp, and lividity of the face, is very common in new-born children where the labour has been difficult; and therefore without some marks of injury about the neck this would not justify any suspicion of death from strangulation. The only internal appearance is a congested state of the cerebral vessels.

It has been supposed, that the strangulation produced by the wilful application of any constricting force to the neck, would be known from the accidental strangulation caused by the cord, by the fact that in the former case, there would be a livid or ecchymosed mark or depression on the neck. But in answer to this view, it may be observed, that such a mark, although from the unnecessary violence used, a common, is not a constant accompaniment of homicidal strangulation. On the other hand, although it was formerly a disputed question, it is now certain that the umbilical cord may itself produce a livid or ecchymosed depression. By trusting to this mark as an absolute means of diagnosis, therefore, an innocent woman may be unjustly condemned. A case is reported in the Annales d'Hyg. 1841, 127, which involved this question:

A woman was charged with the murder of her child by strangulation. The child had fully and perfectly respired;—the lungs weighed one thousand grains, and when divided every portion floated on water, even after firm compression. There was a mark on the neck, which was superficially ecchymosed in a part of its course. From an investigation of the facts, this appeared to have been a case in which the mark was produced accidentally by the umbilical cord during attempts at self-delivery on the part of the woman. She was nevertheless convicted and condemned to a severe punishment. This case establishes three points: 1, that partial ecchymosis may be produced on the neck by the umbilical cord becoming twisted around it; 2, that this may strangle a child after it has breathed at the outlet,—the cord was twenty-four inches long; 3, that a child's lungs may in a few seconds become sufficiently distended with air to give satisfactory evidence of respiration with the pulmonary tests. See p. 463.

In the same journal, p. 428, will be found the report of another case, suggesting many important reflections in regard to the medical jurisprudence of infanticide. In this case the umbilical cord and membranes were actually used by the female as the means of strangulation; the child had not breathed, but was thereby prevented from respiring. There was superficial ecchymosis on each side of the neck over the sterno-cleido-mastoidei. The defence was, that the child was born with the cord round its neck, and that it was accidentally strangled;—but the medical evidence tended to show, that the cord had been violently stretched and used as a means of strangulation. The child had not breathed, and the witnesses considered it to have been born dead, owing to the violence used by the woman. The cause of death here was certainly not strangulation, but arrested circulation. In the mean time, the case proves that ecchymosis may be a result of the constriction produced by the cord. For additional remarks on this subject see Henke's Zeitschrift, 1837, iv. 352; also Ed. M. and S. J. Oct. 1838, p. 282.

A case occurred to Mr. M'Cann, in September, 1838, where the umbilical cord, which was of its full length, had been used as the means of strangulation. It was twisted once round the neck, passed under the left arm over the shoulders, and round the neck again, forming a noose or knot, which pressing upon the throat must have caused strangulation, as the tongue was protruded, and there were other clear indications of the child having been strangled. The hydrostatic test applied to the lungs proved that the child had respired.

When the mark is deep and much ecchymosed, with extravasation of blood beneath, and ruffling or laceration of the skin, it is impossible to attribute this to the effect of the umbilical cord. The lividity produced by the cord in the cases hitherto observed, has been only slight and partial, and unaccompanied by laceration of the skin, or injury to deep-seated parts. For a very instructive case by Dr. Scott, in reference to this point, see Ed. M. and S. J. xxvi. 62. On the other hand, in homicidal strangulation, much more violence being used than is necessary for destroying life, we should commonly expect to find great ecchymosis and extensive injury to the surrounding soft parts. On some occasions all difficulty is removed by the discovery of the rope, tape, or ligature round the neck ; or if this be not found, the proofs of some ligature having been used, will be discovered in the indentations or irregular ecchymosed spots left on the skin, the depressed portions of skin being generally white and the raised edges livid. Marks on the neck may be produced by the umbilical cord without necessarily destroying the child's life ; two cases of this kind are reported by Professor Busch : (B. and F. Med. Rev. x. 579 ;) or the child may be destroyed without ecchymosis being a necessary consequence of the constriction produced by it. For a case of this kind by Dr. Hanff, see Henke's Zeitschrift, 1836, Erg. h. There is much less risk from twisting of the cord than is commonly believed. Out of one hundred and ninety cases, Dr. Churchill found the cord round the neck in fifty-two. The shortest cord so disposed, was eighteen inches long, and it occurred twice in seventy-five cases.

In the fore part of the neck of a child, a mark or depression, is sometimes accidentally produced by forcibly bending the head forwards on the chest, especially when this has been done repeatedly and recently after death. It may happen also during labour. Such a mark must not be mistaken for the effect of homicidal violence. It has been a question whether, independently of the constriction produced by the cord,—the cervix uteri might not cause, during its contractions, an ecchymosed mark on the neck. I am not aware that there is any case reported which bears out this view. It seems highly improbable that any such result should follow.

The mark on the neck is sometimes such as not to be explained by the supposed accidental constriction of the umbilical cord. The ecchymosis may be in detached spots or patches,—situated in the forepart of the neck, and evidently not arising from the application of any ligature. These marks may depend on the forcible application of the fingers to the fore part of the neck of the child, and the indentations have been known to correspond,—a fact which at once led to a suspicion of the mode of death. It may be alleged in defence, that these marks might have been accidentally caused in two ways: 1. By the forcible pressure produced by the child's hand during labour,—an explanation which is highly improbable if respiration have been performed:—although a child has been known to breathe in breech presentations, while the head was still in the vagina. 2. They will be more commonly referred to the violent attempt made by a woman at self-delivery, during a paroxysm of pain. This explanation is by no means improbable, so long as it is confined to injuries probably received during labour; but supposing the marks to have been certainly produced after birth, it will not of course apply. The following case (the Queen v. Ancliffe, Nottingham Lent Assizes, 1842) is in this respect worthy of attention, since it appears to me, to show how a defence of this kind may be sometimes strained:

The evidence proved that the prisoner was delivered of a child, under much suffering, on a stone-floor, and in the presence of another woman,—a witness. The child was born alive, and was heard to cry several times. The witness left it in charge of its mother, and on returning shortly afterwards, she found it dead with black marks upon its throat. The female midwife, who separated the child from the mother, deposed that it gave a sort of half cry;—she thought it was dead when she first saw it, and the marks on the neck were not more than a woman might have caused in attempting to deliver herself. The medical evidence showed that there were many ecchymosed marks about the throat of the child; and on the right side of the neck, blood was extravasated. The marks might have been produced by the fingers:—death had been caused by pressure on the windpipe. The judge left it to the jury to say, whether the marks of violence might not have been unconsciously inflicted by the prisoner during labour. The jury returned a verdict of acquittal.

A medical witness is sometimes asked to state on these occasions, whether the ligature or the fingers had been applied to the neck of the child, before or after death,—or before or after it had breathed. It is proper to observe, that so far as the external marks of strangulation are concerned, there is no difference in the appearances whether the constriction take place during life or immediately after death while the body is warm. Casper's experiments render it highly probable, that where the constricting force is applied to the neck of a dead child at any time within an hour after death, the marks cannot be distinguished by any appearance from those made on a living body. (Wochenschrift, Jan. 1837.) With regard to the second point, it may be stated, that whether the child has breathed or not, provided it be living, the marks of violence present precisely the same characters. The following case is related by Casper.

The body of a new-born child was found concealed in a cellar, and the mother was charged with having murdered it. She confessed that she heard the child cry at the birth, but that it soon died. In about an hour afterwards, she tied tightly round its neck, a band made of a few straws, which she had hastily twisted together for that purpose, in order, as she alleged, "to prevent it from awaking." On the fifth day, the body was examined: the child was mature, well formed and had evidently breathed. The examiners referred death to strangulation:—the woman was convicted and sentenced to be imprisoned for life. An appeal was made against this sentence, and Casper's opinion was called for on the propriety of the medical inference of strangulation during life from the mark on the neck. The witnesses had stated;—"that each straw in the band had produced a well-defined depression, which was whiter than the surrounding skin, while the little folds or elevations between the straws were red;—and on cutting into these reddened portions, slight ecchymosis was found beneath." Casper gave his opinion, that the slight ecchymosis observed, might have resulted from the application of the straw-band soon after death,—while the body was warm; and the circumstantial evidence allowed, that the ligature might have been applied at some time within an hour after death. Hence he declared, that there was a want of proof that this child had died from strangulation. In consequence of this opinion the punishment was mitigated.

It is impossible to deny the correctness of the inference drawn by Casper, since the mark was undoubtedly such, that it might have been produced either before or after death. Which of these two suppositions was the more probable; and whether it was more likely, that a ligature should be put round a child's neck an hour after death to prevent it from awaking (!) or before death for the alleged purpose of destroying it, it was of course for a jury, and not for a medical witness, to decide. If there was nothing more in the prisoner's favour, than her own statement as to the time when she applied the ligature, and her object in applying it, it is certain that a very humane interpretation was put upon the facts. If the court entirely believed Casper's opinion, the woman should have been altogether acquitted, instead of having the punishment merely mitigated. It can be no crime, however absurd and unaccountable it may appear, for a person to place a ligature round the neck of a child after death, to give the appearance of strangulation. When such an extraordinary plea as this is raised, it is a fair matter of inquiry for a jury, to consider the motives of human conduct, and to judge of such a defence on the principles of common sense. If carried too far, no one could be convicted of homicidal strangulation, who was not seen by others to perpetrate the act.

In the case of the Queen v. Wren, tried at the Winchester Lent Ass. 1840, the medical evidence went to show that the child had breathed, and was born alive. There was a piece of tape tied round its neck very tightly, and fastened behind, and there was a discoloration of the skin beneath. The tongue was livid and swollen, and blood was extravasated beneath the scalp. The medical witness admitted that the mark on the neck might have been produced after death; and as he could not positively say that the child had been destroyed by strangulation, the prisoner was acquitted.

Judging from what has occurred on several recent trials, a medical witness must prepare himself for another and more difficult question. Let us suppose it to be admitted as proved, that the ligature was applied to the neck of a child while it was living, and after it had breathed:—it still remains to be determined, whether it was applied before or after the legal birth of the child, or as some judges have laid down the rule, before or after an independent circulation was established in the child's body. In the case of R. v. Enoch, Judge Parke held "that there must be an independent circulation in the child before it can be accounted alive." (Archbold, 367.) By an "independent circulation," we can only understand that condition in which respiration is established, and the blood no longer passes from the mother to the child. Thus, this state would be proved by a cessation of pulsation in the cord; and the crying or audible respiration of the child. It will be seen that this is tantamount to insisting upon absolute proof of respiration as evidence of life; and, therefore, entirely conflicts with the opinions of many other judges, who have held that proof of respiration is not necessary on a charge of murder, because a child might be born alive and not breathe for some time after its birth. (R. v. Brain. Archbold, 367. See antè, p. 441.) If the presence of an independent circulation be the test of a child being legally alive at the time of the violence, the entire birth of its body is certainly not necessary for this; because, as it is well known, respiration may be established, and consequently an independent circulation acquired, before the body of the child is entirely born. Here again, this judgment is opposed to the opinions of most judges, who have repeatedly held that whether a child has breathed or not, entire live birth must be proved. So one of the most common judicial objections to the hydrostatic test, is, that a child may breathe, i. e. substantially acquire an independent circulation, but die before its body is born. In this state of uncertainty, it is very difficult to say what medical evidence is required to prove. If an independent circulation alone is sufficient, it cannot be always necessary to prove entire live birth; but if proof of entire live birth be sufficient, then it cannot be always necessary to show that the child had acquired an independent circulation when the violence was offered to it. In a celebrated case of tenancy by courtesy, (Fish v. Palmer, 1806. pòst, BIRTH,) the judges of that time held that the quivering or spasmodic motion of a lip after birth without respiration, independent circulation, or any other sign of vitality, was sufficient to show that that child was born alive—and that it thereby had acquired civil rights which it could transmit to others,—its heirs. Why is the proof of an independent circulation in a child to be demanded of medical witnesses in a case involving a question of its murder; when in respect to its acquisition of civil rights such a proof is not called for? If the question were fairly considered by all the judges, probably proof of an independent circulation would not be required, at any rate it could not be consistently demanded with the other decisions given, that proof of respiration was not absolutely necessary to constitute live birth in law, even in cases of child-murder. The last case in which this question was raised, was on the Oxford Spring Circuit, 1841, (the Queen v. Wright.) The child was found concealed in a garden, its throat was completely cut, and there was a stab under the left arm. Baron Gurney is reported to have stopped the case; because there was no proof that the child had "an independent existence" when the wounds were inflicted. It is worthy of remark, that one form of murder may be the actual prevention of the establishment of an independent circulation or existence in the child, as where the cord is designedly tied before the commencement of the respiratory process. It has been suggested that ignorance of this point, among midwives, may be the cause of numerous still-births.

In the mean time one fact is obvious, that whether the means of strangulation, if that be the form of murder, be applied to the neck of a living child before the entire birth of its body or afterwards,—before the establishment of an independent circulation (i. e. the act of respiration) or afterwards,—the appearances will be the same; and from these, it will be impossible to say, when the strangulation was accomplished. There is still another novel form which this question has taken. The witness may perhaps be asked, whether the strangulation occurred before or after the umbilical cord was severed. It would appear that the severance of the cord has been regarded as the test of an independent circulation being established in the child:—but this is obviously an error depending on the want of proper information respecting the phenomena which accompany birth. Respiration, and therefore an independent circulation, may exist before the cord is divided, and its severance, which is never likely to take place until after entire birth, cannot consequently be considered as a boundary between a child which is really born alive, and one which is born dead. A premature severance, as it was just now stated, might positively endanger the life of the child, instead of giving it an independent existence. A healthy and vigorous child may continue to live and breathe independently of the mother, before the division of the cord, and the time at which the severance is made depends on mere accident. Hence the marks of strangulation on the neck of a living and breathing child, must be the same, whether the cord be divided or not. The object of putting such a question is not apparent, unless it is intended to be implied, that no child is legally born alive until the accoucheur or the woman herself chooses to sever the cord. It would therefore follow on this doctrine, that to strangle a living child (entirely born) with the umbilical cord, provided this be not lacerated in the attempt, would not constitute infanticide. If this inference be incorrect, it is impossible to see what can have been the object of a judge or counsel in asking a medical witness such a question on these occasions. The following cases will illustrate the difficulties which a witness may have to encounter.

The first is that of Rex v. Crutchley, (Monmouth Lent Assizes 1837.) In this case the body of the child was discovered by a medical man (one of the witnesses) under the prisoner's bed,—she having been secretly delivered of it. There was a riband tied so tightly round its neck in a knot as to have prevented respiration. The child had evidently been dead some hours, and the prisoner alleged that it was born dead. On inspection the face was found swollen, and the lips livid, the lungs contained air and were of a florid colour; they were crepitant and floated on water, so as to leave no doubt that the child had breathed. The vessels of the brain were gorged; the other viscera perfectly healthy. He attributed death to strangulation;—he thought that the ligature had been placed round the neck before the umbilical cord, which had not been tied, was secured; but the reason for this opinion is not stated. He considered that the child had been born *wholly* alive; but admitted that the ligature would have produced the same appearances on the neck, had it been applied before the complete birth of the child. Another witness, however, stated that he thought the ligature might have been placed round the neck before the entire body of the child was born. The defence was, that the ligature had been used by the woman for the purpose of assisting herself in the labour, and that the medical evidence allowed, whether this was the motive or not, that it had been applied before the child was actually born. The judge desired the jury to consider, whether the prisoner wilfully killed the child,—if so, whether the killing occurred before or after the entire birth of its body,—and lastly, whether the killing took place while it was still attached to the body of its mother. Unless the child was destroyed after entire birth, the prisoner would be entitled to an acquittal:—if destroyed, while still attached to the body of its mother, the point would be reserved for the consideration of the judges. The prisoner was acquitted. There can be no doubt that, provided a child be born entirely in a living state, the destruction of it would be murder, whether the cord were severed or not. In the case of the Queen v. Byron, (Chester Aut. Ass. 1838,) the dead body of the child was found with a piece of rag tied round its neck, which in the opinion of the medical witness had caused death by strangulation; but on cross-examination by the judges, he admitted that the appearances might be explained by supposing that the prisoner had produced them in attempting to deliver herself. In the case of the Queen v. Millgate, (Central Criminal Court, Nov. 1842,) the child was discovered dead, and on examination the face was livid, the tongue protruded, and the hands were clenched. Around the neck was a ligature which had been passed round four times, and was tied tightly. The vessels of the brain were turgid, the lungs partially inflated, and the general appearance of the body was healthy. The medical witness thought that the child had been born alive, and had died from the effects of the ligature on the neck. The judge told the jury they must be satisfied that the child was completely born at the time the ligature was put round the neck. The prisoner was acquitted.

In another case, the Queen v. Webster, (Worcester Lent .Ass. 1839,) the following facts were deposed to by the surgeon. The child was full-grown and was born alive:—this was inferred from the lungs being completely inflated. A ligature was found round the neck—it had been passed round twice—was very tight, and fastened in a knot:—it had caused two deep indentations. The vessels of the scalp and brain were turgid with blood, but there were no marks of external violence. Death was caused by strangulation. The judge left it to the jury to say, whether they were satisfied that the child was wholly born into the world alive; and if so, whether the prisoner had knowingly and wilfully destroyed it after it was born. The prisoner was acquitted.

It may be an important question, whether in these cases, the absence of any mark or discoloration of the skin by the ligature, should be taken as evidence of the means of constriction not having been applied during life. What we are entitled to say from observed facts, is, that ecchymosis from the ligature, is not a necessary consequence either in a living or dead child:—although we might expect that there would be few cases of child-murder in which, when strangulation was resorted to, there would not be some ecchymosed mark or discoloration, chiefly on the presumption, that great force is suddenly applied. Besides, it is not improbable that slighter force would cause ecchymosis on the skin of a new-born infant than would be required to produce such an effect on that of the adult. When there is no mark from the ligature, an attempt may be made to show, that death could not have been caused by strangulation, as in the following case, (the Queen v. Hagg,) which was tried at the Carlisle Summer Ass. in 1841.

The medical evidence was to this effect. The deceased child was discovered with a tape tied tightly round its neck. It was full-grown and healthy, and had been born alive, as respiration had been fully established. The lungs filled the chest, floated on water, and crepitated when pressed. From the livid appearance of the face and neck;—the congested state of the brain and extravasation of blood on its surface, combined with the ligature round the neck, the witnesses were of opinion that the child had died from strangulation. On cross-examination, they said that a child may breathe when partially born. The floating of the lungs in water is of itself an uncertain test, if the body is at all decomposed. With other tests it affords a proof of a child having been born alive. One witness said, the ligature had produced no mark of discoloration on the neck, while others said it was perceptible. The inference is, that the mark could not have been very apparent, or there would have been no doubt on this point. It was ingeniously urged in the defence, that the child could not have died from strangulation; because a tape tied so tightly round a child's neck as to cause death in this way, would leave a discoloration, of which no person could have any doubt. The prisoners were convicted.

Had the defence been, as in the former cases, that there was no proof whether the ligature had been applied before or after entire birth, or the establishment of an independent existence in the child, the result might have been different. From the cross-examination, it will be seen, in what way the objections to the hydrostatic test are ingeniously made to affect medical evidence. An answer to a general question is rendered applicable to a particular case. A witness admits on a trial that the lungs may float from putrefaction or artificial inflation:—in short, from other causes than respiration. If this answer be not qualified, an impression is immediately conveyed to the court, and not always removed by a re-examination, that some of those causes may have given rise to the floating of the lungs in that particular instance,—when in fact there may have been not the least trace of putrefaction,—nor the least ground for suspecting that artificial inflation had been practised. As contrasts to this case, see report of a case which occurred to Mr. Coales. G. H. Rep. April, 1842; also one by Dr. Scott, Ed. Med. and Surg. J. xxvi. 62.

Poisoning.—This is placed among the probable means of perpetrating child-murder, but we rarely hear of new-born children being thus destroyed. The earliest age at which I have known a trial to take place, for the murder of a child by poison, was two months. (R. v. South, Norf. Aut. Circ. 1834.) A quantity of arsenic was given to an infant, and it died in three hours and a quarter after the administration of the poison. At this age, the case can scarcely be called one of infanticide in its medico-legal signification; because all that it would be necessary to prove would be the cause of death, the question of life or live-birth would not require to be entered into. If poison should be suspected it must be sought for in the usual way. (See antè, p. 25.)

The duties of a medical witness, as they relate to the mother of the child, generally the accused party, are slight. All that he is required to do, is to show, by an examination made under an order from proper authority, whether or not she has been recently delivered of a child, and to state the probable period at which the delivery took place. (See post, Delivery.) This examination may be necessary in order to connect her delivery with the period which may have elapsed since the birth and death of the child. Unless the examination of the female be made within twelve or fifteen days, no satisfactory evidence of delivery can in general be obtained. It has happened on more than one occasion, that medical men have assumed to themselves the right of enforcing an examination of a suspected female, and by threats or otherwise, compelling her to undergo this. Such a course of conduct is in the highest degree improper:—if a female willingly consents to the examination, or an order be obtained from a magistrate or other official person, the case is different. In taking this authority upon himself, a medical practitioner is forcibly compelling an accused party to produce positive proofs of her guilt, a principle which is entirely opposed to the spirit of English jurisprudence.

From the foregoing considerations it will be seen, that the two great points to be established by medical evidence, in a case of child-murder, are, 1st, that the child was entirely born living when the alleged violence was applied to it; and 2nd, that its death was due to that violence, and to no other cause whatever. The leniency with which such cases are regarded by the law, and the extreme rigour with which the medical evidence, either of live-birth or the cause of death, is treated, must show that they who consider that the use of the hydrostatic test can ever lead to the conviction of an innocent woman, have taken a very limited and incorrect view of the subject. The question of murder rests here, as in all other cases, upon clear and undoubted proof of the cause of death:—and more than this, it must be shown that the violence was criminal, and not by any possibility accidental. Then it must be proved that this violence, if criminal, must have been applied to the body of a child at a particular period, i. e. after entire birth, a case which, from what has already been stated, can rarely admit of clear medical proof. If strangulation, for example, be rendered probable from the facts,—the woman cannot be convicted, unless proof be afforded, 1st, that the child was strangled after its entire body was born; and 2nd, that she could not possibly have produced the marks of strangulation in her convulsive attempts at self-delivery. Medical evidence can rarely be in a condition to establish either of these points, and the assumptions will therefore be, as in the many cases already reported, in favour of the prisoner. A question will probably here suggest itself from the number of *impossible* proofs, so to term them, which the law requires in these cases, namely—How can a conviction for child-murder ever take place where there are no eye-witnesses to the crime? The answer is, that these difficulties may not be raised in the prisoner's favour; but this of course is a matter of accident. On most charges of infanticide, if the counsel for the defence insisted upon clear medical proof of the child being born alive, when the violence was offered to it:—or that respiration, if clearly established by evidence, took place, not during labour, but after complete birth, or after the child had acquired an independent circulation,—neither of these proofs could be possibly afforded; and the case, so far as medical evidence was concerned, would fall to the ground. The frequent acquittals on these charges, most probably depend on the fact, that there may be many extenuating circumstances in the prisoner's favour. She may be young, unfortunate, friendless, and perhaps tempted by a seducer, or by utter destitution, to the perpetration of the crime. According to the present state of our law, the jury have no alternative, but to convict her of a capital offence, or acquit her of the charge of murder, and find her guilty of the concealment of birth, the extreme punishment for which is two years' imprisonment. This is substantially the punishment at present admitted for the crime of infanticide in this country; for it is not to be concealed that *medically* speaking these technical points relative to "live-birth," to "entire birth," or to an "independent circulation in the child," are only so many ingenious means for evading convictions on the capital charge. Whatever doubt may exist according to the forms and principles of law, there can be no doubt medically that living children are often criminally destroyed; and that the law, from the extreme severity of the punishment attached to the crime, cannot reach the perpetrators. In most of these cases the punishment of death would be as much too severe, as the punishment of two years' imprisonment for concealed birth is too slight; and with a full contemplation of this difficulty, the civil code of France (Art. 319) has wisely allowed, on proof of extenuating circumstances, that the court may mitigate the punishment. Some such provision is required in our law, and the unnecessary perplexities which are now thrown on medical evidence, as well as the conflicting opinions on what is live-birth and what is not, would disappear. A change of this kind might undoubtedly be made without prejudice to the innocent.

It is a question which it would be here out of place to discuss, whether a verdict of manslaughter would not be proper on many of these occasions, for to say that the whole offence consists in concealing the birth of a still-born child, is virtually to disbelieve and reject the clear and satisfactory medical evidence often adduced. (See cases antè, the Queen v. Mortiboys, p. 482.) A verdict of manslaughter would not, however, cover those numerous cases where it is *assumed* that the child only lived to respire in the act of birth, and not afterwards. Dr. Christison, in commenting upon these frequent acquittals on the capital charge, and convictions only on a minor offence which cannot always be proved, attributes it to a feeling sometimes entertained in the present day, that the killing of a new-born child, when perpetrated under the impulse of injured honour and the fear of disgrace, should not be classed with the other varieties of murder. (See Ed. M. and S. J., xxvi. 76.) There can, I think, be no doubt that this is the true explanation. (See also case by Mr. Coales, G. H. Rep., April, 1842.)

I may mention in concluding this subject, as the point has given rise to a trial for malapraxis, that if injuries should be criminally inflicted on a child during birth, and the child be born alive and afterwards die from the injuries so caused, the case would be murder or manslaughter, according to the circumstances. The following instance is reported by Chitty. (Med. Jur. 416; also Archbold, 345.)

A man of the name of Senior who, it appears, was an unlicensed medical practitioner, was tried, in 1832, for the manslaughter of an infant by injuries inflicted on it at its birth. The prisoner practised midwifery, and was called to attend the prosecutrix who was taken in labour. The evidence showed, that when the head of the child presented, the prisoner by some mismanagement fractured and otherwise so injured the cranium that it died immediately after it was born. It was argued in defence, that as the child was not born (*in ventre sa mere*) at the time the wounds and injuries were inflicted, the prisoner could not be guilty of manslaughter. The judge, however, held that as the child was born alive and died, the case might be one of manslaughter. This opinion was afterwards confirmed by the other judges, and the prisoner was convicted and sentenced to imprisonment. From the decision in this case, it will be seen that the law makes the question of criminality to depend upon the period at which the injuries prove fatal, and not upon the period at which they were inflicted on the body of a child. The distinction appears to depend on this principle of the criminal law, that the person killed must be a reasonable creature in being and under the king's peace:—therefore to kill a child in its mother's womb is no murder. (Archbold, 345.) The child, unless born alive, does not come under the description above given. Admitting the wisdom of adopting some fixed rule of this kind in a legal view, it is undoubtedly proper that the lives of children in the act of birth should be protected;—at any rate, that their destruction should not be treated, as it now appears to be, with perfect impunity.

It is difficult to determine the number of cases of infanticide which take place annually in this country. But in France, where criminal statistics are more closely attended to, there were, in 1838, one hundred and twenty-nine cases, and in 1841, one hundred and forty-seven cases.

[The principal portion of this section on Infanticide has already appeared in the Guy's Hospital Reports, No. V. Oct. 1837, and No. XIV. April 1842. In a work recently published, (Guy's Principles of Forensic Medicine, Part I. 1843,) the author has adopted some of the views there advocated, and now republished in this volume. This will be, I think, apparent on comparing pp. 162–3 of the "Principles," with p. 343 No. V. and p. 35 No. XIV. of the Guy's Hospital Reports. My reason for adverting to this matter is, that Dr. Guy's work having appeared some time before mine, those who are not acquainted with the facts, might suppose that some of the views here advocated had been borrowed from it.]

DROWNING.

CHAPTER LI.

The cause of death.—Many opinions have been entertained respecting the manner in which death takes place by drowning. It was at one time supposed that the water which passes into the stomach of a drowning animal, had an injurious effect and operated as the immediate cause of death. This opinion prevailed before the importance of the respiratory process in the economy was fully understood. It would, however, have been easy to show the insufficiency of this explanation by a simple appeal to facts. Water is not invariably found in the stomachs of the drowned; and again, it may be introduced into the stomach in much larger quantity than we are accustomed to meet with it in the body of a drowned person, without producing any deleterious effect. The presence of water in the bronchial ramifications of the lungs, has been also suggested as the probable cause of death;—it was thought that it operated here by arresting the circulatoin of blood in the minute pulmonary vessels. This explanation of the cause of death in drowning, would imply that water was always present in the lungs of the drowned, which, however, is not the case; and, indeed, when found, it is often met with in variable quantity,—facts which sufficiently show that this hypothesis cannot be entertained.

Death has been also attributed to a collapse of the lungs, by which the blood is presumed to be mechanically prevented from traversing the pulmonary structure. It is a generally admitted fact, that a considerable quantity of air is, in most cases, expelled from the lungs during the act of drowning, but these organs are not commonly found collapsed in drowned animals,—and when this condition is observed, it is rather to be regarded as a consequence, than a cause of death.

Some have ascribed death in drowning to a congested state of the cerebral vessels,—in other words, they conceive that death takes place in most cases by a species of apoplexy. That a congested state of the cerebral vessels, is often met with in the bodies of the drowned, is a fact which cannot be disputed; but the same degree of congestion is observed, not only in other cases of asphyxia; but also in the inspection of bodies where death has proceeded from various causes, unconnected with cerebral disturbance. There is no ground, therefore, for attributing death to an apoplectic attack;—a mere fulness of the cerebral vessels, is certainly of itself insufficient to justify this view, for upon the same evidence, we might pronounce three-fourths of those deaths which are distinctly referrible to other causes, to be dependent on apoplexy. The obstruction to the passage of the blood through the lungs, is sufficient to explain why we meet with a sanguineous congestion in the cerebral vessels of drowned subjects; and there is great reason to believe that the occurrence of this congestion, is posterior to the interruption of the cerebral functions.

The most characteristic post-mortem appearances of apoplexy,—extravasation of blood, is rarely seen in the drowned, and probably where it exists, it might be traced to mechanical violence before submersion, or to the head coming in contact with hard bodies beneath the water. I have met with only two instances reported, where extravasation of blood on the brain was found:—the one was in the case of Leopold, Duke of Brunswick, who was drowned in the Oder, during the German war, (see Henke Gericht. Med. 327,) and the other was a case which occurred in London in 1839. In general the term apoplexy is applied to those cases of drowning, where there is great fulness of the cerebral vessels:—but there are also in most of these, signs of death from asphyxia.

No doubt now exists among physiologists, that death by drowning is due to asphyxia or suffocation, in which condition the blood is either circulated in a state unfitted to support animal life, or its circulation through the minute vessels of the lungs is wholly arrested. Asphyxia is induced in drowning, owing to a physical impediment to the introduction of air, and we have, therefore, in this form of death, a simple illustration of that state. The medium in which the individual is immersed, acts mechanically and as effectually, as a rope or ligature around the neck; for although air escapes from the lungs, and water penetrates into the bronchiæ, yet no air can enter, to supply the place of that which has already expended a certain quantity of its oxygen on the blood. Hence this fluid must circulate, if it circulate at all, in a state unfitted for the support of existence, and death will ensue.

When an individual falls into water, and is exposed to this kind of death, vain attempts are in the first instance made to respire. At each time the drowning person rises to the surface, a portion of air is received into the lungs, but owing to the mouth being on a level with the liquid, a quantity of water also enters and passes into the fauces. A large quantity of water thus usually passes into the mouth, which the individual feels himself irresistibly compelled to swallow. The struggle for life may continue for a longer or shorter period, according to the strength of the person, but the result is that the blood in the lungs becomes imperfectly aerated and exhaustion follows. The mouth then sinks altogether below the level of the water,—air can no longer enter into the lungs,—a portion of that which they contain is expelled and rises in bubbles to the surface :—an indescribable feeling of delirium supervenes, with a ringing sensation in the ears, the individual loses all consciousness, and dies asphyxiated.

Some persons who fall into water are observed to sink at once without making any attempt to extricate themselves. This may arise from the stunning produced by the fall, and if the fall take place from a great height, the effect is probably aided by the forcible compression which the thorax sustains, whereby the lungs become in great part emptied. Should the individual be intoxicated or otherwise incapacitated, as by striking his head in falling, he may not again rise : and these different conditions under which death may take place, will sufficiently account for the great difference in the appearances met with in the bodies of those who have died under these circumstances.

Some medical jurists have considered that those who were submerged while living, frequently perished by syncope, and often by what has been termed syncopal asphyxia, a mixed condition. It has been supposed that the state of terror into which an individual may be thrown prior to submersion, would be sufficient to bring on syncope, and this, it was presumed, offered an adequate explanation of the recovery of the apparently drowned, when the body had remained a long time in water. It may readily be admitted, that, in some instances, the mental shock may be so great to a person falling into water, as to induce syncope : but it is impossible to determine how often this occurs, and its occurrence appears to be founded rather upon presumption, than upon actual observation.

It is obvious that those who die from apoplexy, concussion or syncope at or about the time they fall into water, cannot be said to die from drowning. An individual so situated, makes no effort to respire, and it is only by interfering with respiration, that the water operates. Admitting then that in strictness, asphyxia is the sole cause of death in drowning, the subject is of interest in medical jurisprudence, only because the apparent may be mistaken for the real cause. It may also be occasionally necessary to determine whether the person really died by drowning or not, i. e. whether he was asphyxiated by water or not :—since an answer to this question may materially affect the position of an individual charged with homicide. The conclusion at which we arrive is, that many persons may fall into water and appear to be drowned, whose deaths have actually preceded their submersion. They may have died from fright or terror at their situation, or have been killed by their heads coming accidentally in contact with hard bodies during the fall, or even with the surface of water itself; for this may be sometimes sufficiently resisting to produce concussion of the brain when the fall is from a great height, and the head comes first in contact with the water. It is probable that some also perish owing to a shock received at the pit of the stomach by the violence of the fall. A shock thus received in the region of the heart, might possibly suspend the functions of that organ, and kill the person by inducing sudden syncope. A case is mentioned in the Dublin Medical Journal, for May 1837, which appears to bear out this view.

Drowning may operate indirectly as the cause of death. Thus it has been repeatedly remarked, that those who have been rescued from the water in a living state, in spite of the application of the usual restoratives, have after some minutes or hours died. Death in such cases must be attributed to the exhaustion induced by the struggles of the individual for life, or by the long contact of the body with a cold medium.

According to M. Devergie, (Méd. Lég. ii. 336,) of one hundred individuals who fall into the water or are exposed to the chances of drowning,—the following may be taken as the numerical ratio of the causes of death.

Asphyxia pure	25·0	Asphyxia	87·5
——— and Syncope ——— and Cereb. Congestion	62 5		
Syncope, Apoplexy, or Concussion			12·5
			100·0

From this table we learn that out of one hundred bodies, removed dead from water, where death was due either directly or indirectly to immersion,—if the body be removed immediately after death, and examined soon after removal, the signs of drowning would be present in about 25:—they would be imperfectly apparent (asphyxia more or less marked) in about 62, and they would be wholly absent in about 12. This table may not represent the actual truth, but as the medical jurists of Paris have ample opportunities of examining the drowned, it is probably as near an approximation, as the present state of science will permit us to reach.

Period at which death takes place.—A witness may be asked how long a time is required for death to take place by drowning. In giving an answer to this question, it must be remembered that all who fall into water and are exposed to the risk of drowning, do not really die by that kind of death. Thus all cases of death from syncope or apoplexy must be excluded from our consideration. Again some persons who are strong, who are good swimmers and retain their presence of mind,—may support themselves for a length of time in water, while others who are weak and delicate, may struggle only for a few seconds, and then sink exhausted and lifeless. There are two very different points involved in this inquiry: 1. How long can a person remain beneath the surface of water without becoming aspyhxiated, (drowned?) and 2. After what period of entire submersion of the body, may we hope to resuscitate a person?

In regard to the first point it may be observed, that when the mouth is so covered that air cannot enter, asphyxia supervenes in the course of one or two minutes at the farthest, and the time at which this occurs, does not appear to vary materially with the individual. It has been observed that perfect insensibility has supervened after a minute's submersion, and it is probable that in most cases, a few moments would suffice for the commencement of asphyxia. In the case of a diver who was accidentally submersed, at Spithead in July 1842, for a minute and a half, without the power of breathing at the depth of eighty-feet, it was observed that when drawn up he was faint, but sensible. (Med. Gaz. xxxi. 90.) Observations made upon sponge and pearl-divers, show us for how short a period a human being, even when practised in the art of diving, can continue without breathing. Dr. Lefevre, of Rochefort, found that among the Navarino sponge divers, accustomed as they are to the practice of diving, there was not one who could sustain entire submersion of the body for two consecutive minutes. The average period of entire submersion, was seventy-six seconds. (Med. Gaz. xvi. 608.) According to Mr. Marshall, the best pearl-divers of Ceylon could rarely sustain a submersion of more than fifty seconds. Thus then it would appear from these and other observations, that asphyxia is probably induced in most individuals in the course of a few seconds, and that at the furthest it occurs in from a minute to a minute and a half.

The second point to be considered is—how long a period of entire submersion is required for death to take place, i. e. when is there no further hope of resuscitating a drowned subject? This question is of great importance in relation to the treatment of the drowned. The insensibility which is the result of submersion, will give to a body which has been immersed only a few minutes or even seconds, the characters of apparent death; but we are not, therefore, to desist from applying every means in our power to restore animation. On the contrary, it is only a proper act of humanity that the means should be applied without delay, even to subjects which have remained so long in water, as to afford, physiologically speaking, but little hope of ultimate resuscitation. A man who would neglect the application of these, would consign the body to certain death, while, by adopting an opposite course, he might, perhaps unexpectedly to himself, be the means of restoring a fellow-creature to existence. Hence we are not to allow ourselves to be influenced, in the treatment of the drowned, by the shortness of the period at which death must commonly take place: for it is possible that two individuals may be drowned under the same circumstances, and treated, on removal from the water, in the same way; and yet the means of resuscitation will be effectual in one case, while they will totally fail in the other. It ought to be borne in mind, that the susceptibility to the restoration of life may be different in the two subjects: were this not the case, it would be impossible to explain why, under the most judicious treatment, every effort will fail in restoring animation in a subject which has been submerged only a few minutes, while the same means will perfectly succeed in resuscitating another subject which may have been submerged more than twice the period.

Devergie states that it has been found impossible to restore some who had not been entirely submersed for more than a minute, and when the bodies were removed with all the warmth and pliancy of life about them: but on the other hand others have been recovered, who there was reason to believe, had been *entirely* submersed for several minutes. It is necessary that these circumstances should be clearly explained; for many of the marvellous recoveries reported, have no doubt been cases of the resuscitation of individuals who had not been entirely submersed with the head below the water, for the period alleged. If we are called upon to state physiologically, how we can reconcile the accounts of resuscitation after the body has remained for a quarter of an hour, or even for a longer period, in water, with the fact of the general occurrence of death within the short interval of a few seconds or minutes from the time of submersion, we must look upon such accounts, provided their authenticity be placed beyond all doubt, as extraordinary exceptions to a very widely-extended rule. It is necessary to observe that the head of the subject may not have been under water during the whole of this time; the individual may have struggled long, and have risen frequently to the surface, or the upper part of his body may have received support from some mechanical obstacle. All these circumstances, as well as the depth of the water in which the body is found, should be duly considered before we proceed to admit statements, which are opposed to facts well established by experiment and observation. In most of the cases on record, the evidence has been derived from ill-informed and ignorant persons, who were but little fitted to convey accurate information upon so important a question, and whose conjectures we should be extremely cautious in receiving. Besides the period of submersion has been stated upon conjecture, not upon actual observation of the time.

The following facts, it appears to me, may be relied on, in relation to this question. Mr. Woolley, a medical assistant of the Royal Humane Society, doubts, whether in the records of the society, there is a single well-authenticated instance of resuscitation after an entire submersion of five consecutive minutes. (Lanc. Jan. 1836.) Subsequently to this, however, he met with a case where the individual was recovered after five minutes' submersion. (Lanc. Oct. 1841.) In the Report of the R. H. Society for 1840, there were two cases of successful resuscitation after one minute and a half,—and two cases after three entire minutes' submersion. In a case communicated to me by Mr. Bloomfield, in 1841, a boy was recovered after a submermersion of from five to ten minutes. In another, communicated to the Lancet by Mr. Smethurst, (July 1841,) a girl aged two years was recovered after ten minutes' immersion—it is not quite certain whether in this case the whole of the body was under water during that time. A case of recovery after six minutes' alleged submersion will be found in the Med. Gaz. (xxix. 78.) In the same journal (xxxi. 448) is perhaps one of the most remarkable of these cases, where an individual is stated to have been resuscitated after fourteen minutes' submersion; and the case carries with it great probability, although the time was rather a matter of calculation from circumstances than actual observation. This is the longest authentic period with which I have been able to meet. Cases of alleged recovery, after half an hour and even three quarters of an hour, will be found reported;—some have endeavoured to explain these by assuming that the individuals in question, were restored from a form of syncope, which had occurred in consequence of the mental shock experienced at the moment of submersion. It has been admitted that syncope may occur under these circumstances, and it is possible, also, that the susceptibility of resuscitation may remain longer in a subject labouring under syncope, than in one who has perished by asphyxia: but the question here obviously presents itself, whether the lungs can cease to act and the heart to circulate blood for the period of half an hour, consistently with the maintenance of life. The medical jurist must remember, that neither of these functions can continue when the body remains entirely submerged: for it is impossible that air can enter into the lungs, and we know that the circulation, provided syncope be not previously induced, is not maintained above three or four minutes in a subject so situated. There are few indeed who would be disposed to admit, that respiration and circulation could remain so long entirely suspended in any individual, whether he be in a state of syncope or asphyxia, without the complete destruction of life, or if they did admit the possible occurrence of so great a deviation from the common phenomena of vitality, they would require far better evidence for such an admission, than that by which these cases are usually supported. In numerous experiments on drowned animals, I have never found that life could be restored, after the animal had remained entirely submerged for the space of four minutes. In one case where an individual had been submerged five minutes, and every means for resuscitation speedily used, the result was unfavourable. We are then bound unhesitatingly to declare, that in drowning, life is very speedily destroyed,—that the time within which resuscitation may be successfully attempted, is subject to variation,—and, lastly, that the cases which have been hitherto recorded of restoration after the lengthened submersion of half an hour and upwards, are to be regarded as extravagant fables.

TREATMENT.—A question has often arisen on a coroner's inquest as to whether death may not have been really due to neglect in the treatment. The principles to be observed are, 1. To wipe the body dry. 2. To keep the head and shoulders raised. 3. To restore the warmth of the body. This may be done according to the means at hand, by warm blankets,—bottles of hot water,—bags of hot sand,—the warm water bath or the warm air bath. (For an account of the latter see Med. Gaz. Sept. 1838.) The warmth should be especially applied to the feet and epigastrium. 4. The cautious application of stimulants, such as diluted ammonia, to the nostrils. 5. Having cleared the mouth and fauces, to move the chest in order to simulate the act of respiration. 6. The employment of stimulating embrocations such as the Lin. Camph. Comp. rubbed by a warm flannel on the trunk and the extremities.

Much difference of opinion exists on the propriety of introducing air into the lungs by artificial processes. Mr. Woolley, who has had considerable experience in these matters, denies its efficacy, (Med. Gaz. xvii. 663,) and states that in the cases in which he had been successful in resuscitating the drowned, he had not inflated the lungs. This is certainly strong evidence against the utility of the practice, and it is corroborated by the observation of Dr. Douglass, (Med. Gaz. xxxi. 449,) one of the most remarkable cases of resuscitation on record; for the individual here had been fourteen minutes under water, and no signs of returning animation were evinced until the treatment,—which consisted simply in the application of warmth and constant friction, had been persisted in for eight hours and a half from the time of the accident. Inflation of the lungs was tried, but not persisted in: it not appearing to be attended with any effect and interfering with the rubbing, on which the greatest dependence was placed. Artificial inflation is commonly used, and it is said successfully:—but other means, under which alone the apparently drowned have often recovered, have been simultaneously employed, so that it is rather difficult to say what share the inflation really had in the recovery. Certainly it should never be allowed to interfere with the application of those means by which warmth is restored to the skin. Dr. Todd has recommended the use of electricity, but the obvious objection is that the means for this are not commonly at hand, and whatever is done on these occasions must be done quickly. Although the individual may have been only one minute submersed, if much time has elapsed before the means for resuscitation are employed, there can be no hope of success. It has been stated that after ten or fifteen minutes' submersion, there is but little hope of recovery, yet these attempts at restoring animation often fail from the delay which ensues in obtaining the means. Thus there will be a better chance of recovering one who has been five minutes submersed, where the treatment is immediate, than another who may have been only two minutes submersed, but where a delay of from ten to fifteen minutes has occurred in the application of the means. This obstacle to recovery is often overlooked, —attention being paid to the period of submersion only. On these occasions we should not be justified in declining to employ the means for resuscitation, merely because the body was cold and apparently lifeless.

Another point to be considered is for how long a period should the efforts at restoration be continued. When the treatment is commenced under circumstances which justify a fair hope of success, it would be proper to continue the treatment for at least an hour. In Mr. Bloomfield's case, an hour and a half elapsed before there were any signs of returning animation. In Dr. Douglass's case resuscitation began only to be feebly established after eight hours and a half spent in the treatment. There is no doubt that this case would have been abandoned as hopeless by many, long before this period; especially as the man had been submersed fourteen minutes: and thus perhaps many persons are lost who might be recovered by perseverance. The tendency to restoration is often evinced by the occurrence of slight lividity in the face and convulsive twitchings of the facial muscles. So soon as resuscitation commences, it will be proper to abstract blood cautiously. In Paris, from 1821 to 1826, out of five hundred and seventy-six cases, four hundred and thirty were saved.

POST-MORTEM APPEARANCES.—In conducting the examination of the body of a drowned person, it is necessary to remember, that the external and internal appearances will vary much, according to the time which the body may have remained in water, or the period which may have elapsed, after its removal and before it is examined. Two subjects may be taken out of water at the same time, one may be examined immediately, while the examination of the other may be deferred for several days. In these cases, the post-mortem appearances will be no longer similar; and the difference will be particularly great when the last-mentioned body has been exposed to a high temperature, and to the free access of air.

Supposing that the body has remained in the water only a few hours after death, and the inspection has taken place immediately on its removal, the *skin* will be found cold and pallid, sometimes contracted under the form of cutis anserina. (Ed. Med. Jour. Jan. 1837.) Livid discolorations of greater or less extent may be observed. The face is pale and calm, the eyes half open, and the pupils dilated, the mouth closed or half open, the tongue swollen and congested, frequently pushed forwards to the internal edges of the lips, sometimes lacerated by the teeth;—and the lips together with the nostrils, covered by a mucous froth which oozes from them. If the body have been submerged for a longer period, or have remained long exposed before inspection, the skin will be found variously discoloured according to the degree to which putrefaction may have advanced. If three or four months have elapsed before its removal, the skin covering the legs may be, in the first instance, of a deep blue colour: but if the body be exposed to air, this colour gradually disappears, and the skin becomes brown.

The influence of air upon the skin of a drowned subject, is most remarkable in the face and thorax. When the body has remained for some days in water and has been exposed for a few hours only after its removal, the temperature of the atmosphere being moderately high, the face will commonly be found livid and bloated, and the features so distorted, that they will be with difficulty recognizable. The change chiefly consists in the skin becoming at first of a livid brown colour, which gradually passes into a deep green.—That these effects are to be ascribed to the free contact of air, appears evident from the fact, that they are most fully developed in those parts of the body, which are the most exposed to the atmosphere. Thus, these changes of colour in the skin are not commonly met with where any parts of the cutaneous surface have been in close contact, as in the axillæ and inner surfaces of the upper and lower extremities, where the former have been closely applied to the sides of the trunk, and the latter have remained in close proximity to each other. For the same reason the discoloration is not commonly observed at the back of a subject, or where the body has been tightly wrapped in clothes.

There is another external appearance which is sometimes met with in the drowned; the fingers occasionally present *abrasions*, and gravel, sand, or other substances may be found locked within the hands or nails of drowned subjects; for in the act of drowning, as common experience testifies, an individual will grasp at any object within his reach, and in his efforts to extricate himself, he may excoriate or wound his fingers. There are, however, many cases of drowning, in which this sign is absent. There may be no substance for the drowning person to grasp;—this will depend in a great degree upon the fact of the water being deep or shallow, of its being confined within a narrow channel or not, and many other contingencies. In all cases, when the individual is senseless before he falls into water, or when his death is occasioned by syncope from sudden terror, he will of course be incapable of making those exertions, which are necessary to the production of this appearance. The palms of the hands and soles of the feet have been found white and sodden from imbibition when the body has remained several days in water.

On examining the body *internally*, we may expect to find in a recently drowned subject that the viscera of the thorax will present the appearances indicative of asphyxia. The right cavities of the heart, and the vessels connected with them, are distended with blood,—the lungs are sometimes found gorged, and at others pale and collapsed. If the subject has remained a long time in water before the inspection is made, the viscera of the thorax will not present the characters above described. Independently of the changes which may have taken place in consequence of putrefaction, the right cavities of the heart, and the vessels immediately connected with them, will be found collapsed and generally destitute of blood.

Some physiologists have asserted that the *blood* remains fluid in the bodies of the drowned. Orfila observes, that with one exception, he has not met with the blood in a coagulated state, in the examination of a drowned person. Probably much more importance has been attached to this appearance than it really merits. Some observers have found the blood coagulated in the drowned; and I have repeatedly seen coagula, like those usually met with after death, in the bodies of animals which were drowned for the sake of experiment. If the blood be generally found liquid, this may be due to putrefactive changes or to the imbibition of water.

A greater or less fulness of the vessels of the *brain* is described as one of the appearances met with in a drowned subject. Some remarks have been already made on this point, and from these it is evident, that the state of the cerebral vessels can afford no presumption that death has taken place by drowning. In regard to the cases which I have had an opportunity of examining, the quantity of blood contained within the cerebral vessels, has rarely been so great, as to call for particular notice.

In examining the viscera of the abdomen, it will commonly be found that the *stomach* contains a certain quantity of water, which appears to enter into this organ by deglutition. The quantity is subject to great variation; sometimes it is large, at other times small, and in some instances no water whatever is met with. Orfila has remarked that the alimentary canal is occasionally much discoloured in drowned subjects. He observed, also, that when drowning took place while the process of digestion was going on, the mucous membrane of the stomach often had a red or violet tint. When the drowned subject had remained a long time in water, the lining membrane of the stomach was observed to acquire a very deep violet or brown colour. A knowledge of this fact, will be of importance in those cases, where the subject removed from water, is suspected to have been poisoned previously to submersion.

Among the other appearances met with in the body of a recently drowned person which require to be mentioned, is the presence of a *mucous froth,* sometimes of a sanguineous hue, covering the lining membrane of the trachea, which may be itself slightly reddened. Water is also occasionally found in the ramifications of the bronchiæ, but in very variable quantity. If the body has remained a long time in water, or if, after removal, it has been exposed to the air for several days previously to the inspection being made, there is commonly no appearance of mucous froth in the trachea or its ramifications.

WAS DEATH CAUSED BY DROWNING?—It is obvious that for a correct solution of this question, we shall have to consider the appearances met with in the bodies of the drowned, and to determine how far they are characteristic of this form of death. Among the *external* signs of drowning, when the body is seen soon after death, are paleness of the surface and the presence of a mucous froth about the nostrils and lips. The absence of these appearances, however, would not prove that the individual had not been drowned: for if the body has remained some time in water, or if it has been long exposed to air before it is seen by a medical practitioner, the cutaneous surface may have undergone various changes of colour, and mucous froth may no longer be found adhering to the nostrils and lips.

In speaking of the external appearances of the body, it was stated that foreign substances are sometimes locked within the hands or lodged under the nails of drowned subjects. This fact may occasionally afford strong circumstantial evidence of the manner in which the individual has died. If materials be grasped within the hands of the deceased, which have evidently been torn from the banks of a canal or river, or from the bottom of the water in which the body is found, we have strong presumptive evidence that the individual died within the water. For although it is possible to imagine that the deceased may have struggled on the bank and have been killed prior to submersion, yet in the value attached to this sign, we are presuming that there are no marks of violence on the person, nor any other appearances about the body, sufficiently striking to lead the examiner to suspect that death has taken place in any other way than by drowning. If the substance, locked within the fingers or finger-nails, be sand of the same characters as that existing at the bottom of the river or pond, it is difficult to conceive any stronger evidence to establish the fact of death having taken place subsequently to submersion. The abrasion of the fingers is a circumstance of minor importance,—no value could be attached to this state of the fingers as an indication of the individual having perished by drowning, unless it were in conjunction with the appearance above described. A witness would be constrained to admit in many cases, that the extremities of the fingers might become abraded or excoriated after death, or even before submersion, while in no case could he be called upon to make an admission, in regard to substances found grasped within the hands, which would invalidate the evidence deducible from this condition. This must be regarded as a most satisfactory proof of the individual having been alive after his body was in the water. It is well known that when two or three persons are drowned by the same accident, they are not unfrequently found clapsed within each other's arms,—a fact which at once proves that they must have been living when submerged. So if a dead body be discovered still holding to a rope, cable, or oar, no further evidence is required to show that the deceased must have died by drowning.

The signs upon which medical jurists chiefly rely as proofs of death from drowning are water in the stomach, and water with a mucous froth in the trachea and lungs.

Water in the stomach. — It has been stated, that water commonly passes into the stomach of a living animal while drowning, and this most probably takes place by the act of deglutition: for it has been observed, that when the animal was stunned prior to submersion, water did not pass down the œsophagus. As a proof that its entrance into that organ, depends on deglutition, it may be stated, that the quantity contained within the stomach is greater when the animal is allowed to come frequently to the surface and respire, than when it is maintained altogether below the surface. The power of deglutition is immediately suspended on the occurrence of asphyxia, and in this way, may we perhaps most satisfactorily account for the difference observed in the two cases. The water thus found is in variable quantity; there are cases of drowning in which water is not discovered in the organ. It was found by Dr. Ogston, of Dundee, in five cases out of seven. (Ed. Medical Journal, January 1837.) In dissecting cats which had been drowned, I have repeatedly remarked, the absence of water from the stomach; in these cases, the animals had been invariably kept under water from the first moment of their submersion, and thus in a condition but little favourable to the exercise of deglutition. Water does not readily penetrate into the stomach of a subject which has been thrown in after death; the parietes of the œsophagus applying themselves too closely to each other, to allow of the passage of the fluid. If putrefaction has advanced to any extent, it is possible that water may enter; but the practitioner will easily judge from the state of the body, how far this process may have been concerned in the admission of the fluid into the stomach and alimentary canal. It has been suggested that water may be found in the stomach of a subject apparently drowned, in consequence of that liquid having been drunk by the individual or artificially injected by another into the stomach after death. It is difficult to conceive under what circumstances such an injection could be made, or what purpose it would answer. The quantity would determine whether it was likely to have been drunk by the person before immersion. It is of course presumed, that the liquid contained within this organ, is of the same nature as that in which the body is immersed; for it is possible that fresh water may be found in the stomach of a person drowned in salt water, and in such a case it would be obviously improper for a medical witness to affirm from the mere existence of water internally, that the individual had died within the medium in which his body was discovered. If the water contain duckweed, moss, or any substance existing in the pond or river where the drowning occurred, this is a proof of its having been swallowed by a living person,—when the inspection is recent. The absence of water from the stomach cannot lead to the inference that the person has not died by drowning, because in some instances it is not swallowed, in others it may drain away and be lost after death.

The following case occurred at Maidstone, in July 1843. The body of a young woman was found in the Medway, under circumstances that led to a suspicion of murder. The medical witness deposed that there were no marks of external violence nor any sign of the deceased having struggled with the supposed murderers. There was some long grass at the back of the mouth, and in the fauces. The grass was not the same as that growing on the banks of the river, but such as grew at the bottom, and which the deceased had probably swallowed after having gone living into the water. On this evidence the accused was discharged.

Mucous froth in the trachea and lungs.—The trachea in a drowned subject is frequently covered by a mucous froth, and this is stated, in some instances, to have been so abundant, as to have filled the bronchi and their ramifications. It is sometimes disposed in a layer of minute vesicles, tinged with blood. The origin of this appearance has been variously accounted for; but it appears to be produced by the simple agitation or admixture of the air respired in the act of drowning with the mucous secretion of the air passages, which, perhaps under these circumstances, is more copiously poured out.

This mucous froth is not always met with in drowned subjects: 1. It has not been found in those who have sunk at once below the surface. 2. The appearance may not be seen where the subject has remained for a long period in the water after death, since by the free passage of this fluid into and out of the trachea, the mucous froth, although formed in the first instance, will disappear. 3. If, after removal from the water, the subject be exposed to the air for several days before it is examined, it is rare that this appearance is seen. 4. The mucous froth may be formed in the trachea, but it may be entirely removed by the incautious manner in which the body may have been handled on its removal from the water. Thus, if the subject be removed from water with the head depending, any fluid which may be contained within the lungs will escape, and in passing through the trachea, this fluid may effectually obliterate the frothy appearance if it previously existed.

A similar appearance has been found in those who have been hanged, or who have died from apoplexy. The introduction of any liquid into the trachea during deglutition, may produce it. A case is reported where, in poisoning by laudanum, water containing sulphuric ether was forced down the throat of a person after the power of swallowing had ceased. On dissection, a quantity of reddish froth was found filling up part of the trachea.

Water in the lungs.—Many contradictory statements have appeared relative to the presence of water in the lungs of the drowned; but it is not unfrequently found, for the glottis does not in every case of drowning become so effectually closed, as to prevent the introduction of a portion of liquid into the pulmonary cells. In some cases there is none; and when present the quantity which is found in the bronchiæ after death, depends on many contingencies. It is commonly small, often about an ounce, but it is subject to variation, and is probably affected by the number of forced attempts at expiration made by the drowning animal. In my experiments on animals, I have not remarked any difference in the quantity whether the animal were allowed to rise to the surface and respire, or whether it were maintained altogether below. There is but little doubt that the quantity becomes increased after death, because it is now well-known that water will penetrate into the lungs, when a body has been thrown in dead, and before the access of putrefaction. This it is important for a medical jurist to bear in mind, as it may influence materially the opinion which he may be disposed to form on the discovery of water in the lungs of an apparently drowned subject.

From these observations, it will be perceived that water may be present in the lungs, and yet it will afford no evidence of drowning, since it is capable of penetrating into these organs in a dead subject. It has been also suggested that water may have been injected into the lungs after death, in which case, an incorrect opinion may be formed from its presence, if the body were discovered on the bank of a river or canal. This, however, is an obstacle but little likely to interfere with medical investigation.

On the other hand, the absence of water from the lungs of a subject found apparently drowned, must not be considered to indicate that death was not a consequence of drowning; for if the body be removed from water and allowed to remain with the head depending, the water originally contained within the lungs, will drain out; or if it be long exposed before undergoing an examination, the probability is, that none will be discovered in these organs, since in the progress of time it may disappear by imbibition and evaporation.

BUOYANCY OF THE BODY.—It is to be remarked that the human body whether living or dead, will equally sink,—its specific gravity being somewhat greater than that of water. If a dead body be found floating or on the surface of water, it must either be suspended by some mechanical cause, or by the air generated from putrefaction. A strange error formerly existed on this point: it was thought that those who died in water (by drowning) sank, while the bodies of those who were thrown in dead, floated. See the trial of Spencer Cowper, Hertford Assizes, 1699. It was here brought forward as a proof of murder by strangulation, that the body of the deceased, a female, was found floating in a pond, and hence it was contended that she must have been dead before her body was put into the pond!

The bodies of the drowned, when they float from putrefaction, generally rise to the surface about the fourth or fifth day after submersion, unless held down by mechanical obstacles. Male subjects commonly float with the back on the surface, while female subjects float with the abdomen on the surface of water.

The body of a drowned person when it has been long in water, sometimes undergoes certain peculiar changes, by which a fatty compound, adipocere, is produced. The experiments of Chevreul have proved that this compound is an animal soap, with a base of ammonia or lime, the former alkali being the result of the decomposition of the nitrogenized principles of the body, while the fat is acidified. A medico-legal question has more than once arisen respecting the length of time which a body should remain in water, in order that this adipocerous transformation of the tissues may be observed. Dr. Gibbs, of Bath, found that by macerating muscle in water for about a month, he was only able to procure a small quantity of adipocere. Dr. Harlan, of Philadelphia, observed that the integuments of a cranium were, by maceration, converted into adipocere in about six weeks. In some experiments which I have made on the subject, the conversion of muscle and fat to adipocere was not complete in stagnant water, under a period of two months. Thus, then, we may say, that a month is about the earliest period at which this change is likely to be observed. The experiments of Orfila and Devergie, prove, that with bodies interred in the soil, the change is much longer in taking place. The following singular case will show the medico-legal relations of this subject. It was tried at the Warwick Lent Assizes, in 1805.

A gentleman who was insolvent, left his home on the 3d November, and on the 12th December following, his body was found floating in a river much decomposed, and the dress rotten. There was no doubt that he had committed suicide. A few days after he was missed, a commission of bankruptcy had been issued against him; and the question was, whether or not he was living at the time it was issued. If not living, then the commission was void. As nothing positive was known on the subject, the only evidence on the point, was derived from an examination of the body. The muscles of the lower part of the abdomen and the glutei were found to have become converted into adipocere; and from this fact, it was inferred to be in the highest degree probable, that his body had been in the water during the whole period of his absence—thirty-nine days; in short, that he had drowned himself on the day he left the house. Several medical witnesses were summoned on both sides. Dr. Gibbs and two others gave a strong opinion, that from the slow formation of adipocere in the drowned, it was reasonable to infer, that the body of the deceased had been in the water for the whole period of five weeks and four days. The jury returned a verdict in accordance with this view, namely, that the deceased was not living at the time the commission was issued against him. Mr. Callaway has informed me, that he was required to give evidence in a similar case in the year 1836.

We have now reviewed the whole of the evidence, which the postmortem examination of a drowned subject, is capable of affording to a medical witness. It will be seen that the only characters met with internally, upon which any confidence can be placed to indicate that the individual has been drowned, are the presence of water in the stomach, and the presence of a mucous froth on the lining membrane of the trachea; but at the same time, the restrictions to the admission of these signs as evidence of drowning, may be such as to throw great uncertainty on the correctness of a medico-legal opinion, founded simply on their existence. The practitioner must then determine, before he decides positively in a question of this nature,—whether there be any appearance about the person which would lead to the suspicion that death had been caused in another way. When he has provided himself with this negative evidence, and he finds that the characters already enumerated, are present;—or if absent, he can, with any show of probability, account for their absence,—he is then justified in giving a decided opinion on the subject.

In consequence of the uncertainty relative to the appearances of drowning, barristers have considerable advantage in cross-examining those medical witnesses who appear for the prosecution. Legal ingenuity is here often carried to the utmost, to show that there is no positive or well-defined sign of drowning; and therefore to draw the inference that the deceased must have died from some other cause. A trial took place at the Central Criminal Court, April 1841, in which the witnesses were very severely examined on the appearances of drowning. (The Queen v. Longley.) The general impression among non-medical men appears to be, that whether in drowning or suffocation, there ought to be some particular visible change to indicate at once the kind of death; but it need hardly be said that this notion is founded on very false views; and if the reception of medical evidence as to the cause of death, be made to depend on the production of some such positive and visible change,—then it would be better at once not to place the parties charged with the offence upon their trial, because the crime could never be proved against them. A medical inference of drowning is founded upon a certain series of facts, to each of which individually it might be easy to oppose plausible objections; but taken together, they often furnish evidence as strong as is commonly required for proof of any other kind of death. In the case above referred to, the prisoner was cleverly defended. The deceased, a child, was drowned by the mother. When the body was removed from the water, the mouth was closed: the prisoner's counsel wanted to make it appear, that it was most usual to find the mouth open in cases of drowning; and then went on to say, that "the only proof of suffocation by drowning which had been adduced by the medical witness, was the frothy mucus found in the air-cells,—that it could not have got through the mouth was quite certain, because the mouth was proved to have been closed. The air might have passed into the air-cells of the child, whilst struggling in its mother's arms, just as well as whilst struggling in water!" After what has been stated, it is not necessary to point out the fallacy of the assumptions involved in this argument; but it is much to be regretted, that medical evidence should be allowed to be presented to a jury in such a perverted form. The wonder is, that even in a case of undoubted criminality (as in this particular instance) a conviction should ever occur. See also the case of the Queen v. Owen, Thomas and Ellis. Stafford Lent Assizes, 1840.

Marks of violence on the drowned.—The chief inquiry with regard to marks of violence on the drowned is, whether they resulted from accident or design, and in forming an opinion a witness must give due value to the accidents to which a body, floating loosely in water, may be exposed. Ecchymoses of considerable size, are sometimes seen on drowned subjects, where they have been carried by a current against mechanical obstacles in a river or canal. If the deceased fell from a considerable height into water, his body, in falling, may have struck against a bank or projection, and have produced a very extensive mark of violence. It is manifestly impossible to lay down any specific rules for forming a decision in these cases, since probably no two instances will be met with which will be perfectly similar. In clearing up these doubtful points, everything must depend on the tact and acumen of the practitioner who is called upon to conduct the investigation. The first point which he has to determine is, whether the injuries on the body were produced before or after death. (See antè, Wounds, p. 286.) If after death, then they ought to be obviously of accidental origin. Accidental violence may sometimes be of a very serious nature,—so serious that a practitioner might well doubt, whether it did not indicate that the deceased had been violently injured prior to submersion. If a dead body were taken out of water, with one or both extremities dislocated, and a surgeon were asked whether such an injury could be accidental and coincident with or consequent on drowning, the answer would probably be in the negative. But a case has been known where both arms have become accidentally dislocated at the shoulder at the time of drowning; it is that of a man, who, some years since, jumped from the parapet of London Bridge into the Thames for a wager. This exploit, it appears, the man had previously performed with impunity, but in this instance, he sank and was drowned. Both of his arms were dislocated, in consequence, it is presumed, of his having fallen with them in the horizontal position instead of placing them closely to his sides. The concussion on falling into the water, had sufficed to produce the accident. (Smith's For. Med. p. 228.) Here then we have a proof that even the mechanical resistance offered by water alone, may give rise to marks of very violent injury on the person. It has been observed with respect to superficial marks of violence, that bruises or contusions are not always visible on the bodies of the drowned when first removed from water. This may be owing to the skin having abundantly imbibed water, and concealed the colour of the ecchymosis. After a short exposure to air, the water evaporates, and the bruise or contusion becomes visible. The great point with regard to all marks of violence on the drowned, is to throw light upon the questions: 1, whether drowning was really the cause of death; and 2, whether, if so, the act was the result of accident, suicide, or homicide. This last question does not concern a medical witness so much as the jury who will determine the case from the facts proved before them.

It has been already stated, that dislocations may result from accident in the act of drowning, and we must be also prepared to admit, that wounds of a most severe description, such as stabs or gun-shot wounds bearing a mortal character, may be found on the body without justifying an imputation of murder. Suicides have frequently produced on themselves such personal injuries before plunging into the water. So poison may be found in the stomach, and yet all the facts be compatible with suicide.

In June 1838, a female swallowed an ounce and a-half of arsenic, and afterwards threw herself into the river Mersey, from the deck of a vessel. She was picked up and resuscitated, but died in a few hours afterwards from the effects of the poison.

Again, it must be remembered, that the hands and feet may be voluntarily bound by a suicide, and a heavy weight attached to his body, in order the more effectually to accomplish his purpose. All these are conditions which must be so generally known to be compatible with suicide, as scarcely to require the necessity for advising caution. Many instances are reported which show that suicides occasionally resort to the most singular expedients, in order to deprive themselves of the power of struggling against this kind of death. There is, however, one case of rare occurrence, in which a practitioner would be apt to be misled by trusting to the appearances found on the drowned. If a dead body were removed from water with a deep ecchymosed circle round the neck, evidently produced by a cord or ligature, but no traces of which could be found, it is not improbable that a suspicion would be at once raised, that the deceased had been murdered by strangulation, and the body afterwards thrown into water.

An accident occurred a few years since, in which a gentleman and his wife were thrown into the water by the overturning of a small boat. The lady was drowned. On an examination of the body, subsequently made, a livid circle was found round her neck, as if she had been strangled. She had evidently died by drowning, but the mark had been produced by the string of a cloak, which she wore at the time of the accident. In her struggles to reach the boat, it is presumed that the tide had drifted the cloak in the opposite direction, and thus produced the appearance of strangulation. It is not improbable that this accelerated death.

Barzellotti mentions the case of a man who was drowned in the Po, while being escorted along the banks of the river, as a prisoner, by a party of soldiers. The man attempted to escape, and was drowned. Besides the ordinary marks of drowning, there was a deep livid circle, extending completely round the neck, and immediately below this, another mark but paler in colour. The skin over the trachea was ecchymosed. It was supposed that the deceased had been strangled by the soldiers, and his body thrown into the water, but from the appearance of the marks and other circumstances, Barzellotti gave it as his opinion, that it was produced by the collar of a coarse linen shirt which had been tightly buttoned around the man's neck,—the collar had retracted from the imbibition of water, and had thus produced the appearance of strangulation like any other ligature. (Medicina Legale, i. 329.) For another case, see Henke's Zeitschrift, 1840. i. 126. Erg. h.) The following case was mentioned to me as having occurred during the heavy floods in the winter of 1839. A man was carried away and drowned in attempting to ford a swollen stream. When the body was found, it had been so placed by the current, that the fore-part of the neck was locked against the stump of a tree, giving rise to an ecchymosed patch like that which is commonly produced by manual strangulation.

It might be said, that in cases of this description, circumstantial evidence would commonly show how the mark had originated. In admitting the truth of this observation, we must remember that circumstances, as matters of proof, do not always present themselves to our notice, or occur to our judgment at the precise time that the course of justice stands most in need of them. While then we use great caution in drawing an inference where there are such strong grounds for suspicion, we should not neglect to examine carefully the most trivial appearances. In one remarkable case of murder, where the body of the deceased was discovered in a mill-stream, there was only one slight ecchymosed depression in the fore-part of the neck, as if from a finger. The surgeon suspected from this, that the deceased had been strangled. The marks of drowning in the body were wanting. This suspicion was afterwards confirmed by the detection of the criminal.

WAS THE DROWNING THE RESULT OF HOMICIDE, SUICIDE, OR ACCIDENT?—Although the question whether the act of drowning was the result of suicide or murder properly falls within the province of a jury, there are certain points in relation to it which here require to be noticed by a medical witness. In the first place, drowning may take place without the immersion of the entire body in the water.

An interesting case of this kind, which was the subject of a criminal trial, was referred to me by Mr. Aldred, of Norwich, in March 1841. The case was tried at the Norwich Lent Assizes of that year, (The Queen v. Yaxley,) and the prisoner was convicted. It appeared that the mode in which the prisoner destroyed her infant child, was by immersing its head for a few minutes in a pail of water. She removed it before it was quite dead, but it soon died with slight convulsive motions of the limbs. The case was rendered obscure by the fact that the whole of the body had evidently not been immersed, and the only conceivable means of drowning were in a small duck-pond adjoining the house, which was covered with weed, but no weed was found in the stomach, although a quantity of water was there present. A case occurred in London, in 1841, where a drunken man was drowned by falling on the bank of the Surrey Canal, with his head partly in the water, while the greater part of his body lay on the bank out of the water.

It was by partial immersion that the Italian boy, Carlo Ferrari, was destroyed some years since by Bishop and Williams, who afterwards attempted to sell the body for the purposes of dissection. The murderers first intoxicated the deceased, and then suspended him by the heels in a well, so that his mouth was but a few inches below the level of the water.

It has been a debated question, whether a person intent on suicide could have the power to drown himself in shallow water. The occurrence of numerous cases has long since established, that suicide may be perpetrated under these circumstances, as also that death may be due to accident. Thus a man in a state of intoxication may die from drowning, by falling with his face in a shallow stream or pool of water. In short, a depth of water of only a few inches would suffice to cause all the phenomena of death by drowning; but from an external view of the body, the cause of death might not even be suspected.

HANGING.

CHAPTER LII.

Cause of death.—By hanging, we are to understand that kind of death in which the body is wholly or partially suspended by the neck, and the constricting force is the weight of the body itself; while, in strangulation, the constricting force is due to some other cause. In both cases death commonly results from asphyxia, although this must depend in a great measure upon the position of the ligature on the neck. If this be loose, or applied to the upper part of the neck, a small quantity of air may still reach the lungs; and then the cerebral circulation becomes interrupted by the compression of the great vessels of the neck. In this case, apoplexy of the congestive kind is induced, and operates as the immediate cause of death. It is easy to conceive that there may be a mixed condition of asphyxia and apoplexy, and according to the observations of Professors Casper and Remer, this is actually met with in the greater number of instances. The following tables represent the results at which they have arrived from the examination of a large number of cases.

	Remer.	Casper.
Apoplexy	9	9
Asphyxia	6	14
Mixed conditions . . .	68	62
Total . . .	83	85

It has been frequently observed in the execution of criminals, that death does not constantly ensue within the same period of time; and we may probably best explain this fact by a reference to the greater or less degree of constriction produced by the ligature. If the rope should press upon the larynx or above that organ, the occlusion of the air-passages will not be so complete as if it pressed upon the trachea immediately below the cricoid cartilage. A slight degree of respiration might, in the former case, continue for a short interval, by which the life of the person would be prolonged; while in the latter, death would be immediate. If the trachea be in part ossified, the pressure of the cord is less perfect, and death would then take place more slowly.

It has been supposed that the immediate cause of the stoppage of respiration, was pressure produced by the cord on the nerves of the neck, but we must consider it as very improbable that, under the circumstances in which hanging generally takes place, the cord can exert any pressure on the nerves sufficient to produce death. In the greater number of cases of suicidal hanging, which are commonly unattended with much violence, the pressure on these nerves cannot obviously exist; and in violent hanging, the projection of the anterior parts of the neck must suffice to prevent these slender nervous cords from becoming exposed to such a degree of compression, as directly to impede the exercise of their functions.

There is an occasional cause of death in hanging, which appears to have been first brought to the notice of the profession by Louis. Having remarked that, in public executions, death sometimes took place with great rapidity, and in other cases more slowly, he was led to inquire into the circumstances. He found that in the cases of rapid death, the executioner was in the habit of giving a violent rotatory motion to the body of the criminal at the moment it was turned off, whereby a displacement of the dentiform process of the second cervical vertebra took place, so that the spinal marrow became thereby suddenly compressed. This cause of death, although now generally admitted, must be extremely rare:—it is only likely to be observed in very corpulent subjects where a long fall is given to the cord, and where much violence has been at the same time employed by the executioner. It is seldom met with in subjects criminally executed, and in cases of suicidal hanging it is so rare that Devergie found the ligaments between the first and second cervical vertebræ, ruptured only once in fifty-two cases. M. de la Fosse considers, from the observations which he has made on the subject, that, in violent hanging, the dentiform process of the second cervical vertebra, is much more likely to be fractured than to become displaced, and he found this in the case of an executed criminal. On an examination of the body of this subject, he discovered that the two first cervical vertebræ had been completely separated from the remainder of the spinal column by the rupture of the intervertebral substance, and that they were firmly attached by their ligaments to the occipital bone. The dentiform process and body of the second vertebra were detached from the bony ring, and were connected as usual with the anterior arch of the atlas. The spinal marrow had become compressed by the fractured portions of the vertebræ. Probably further observations would show that the injury to the spine is not always of the same nature, and that fractures of the vertebræ are really more frequent than simple luxations of the odontoid process; but, in the mean time, we must admit that such injuries may occur in hanging, and that when they do occur, death must be very sudden. Death appears to take place very rapidly in hanging, and without causing much suffering to the individual. When the suspension of the body has only continued a few minutes, it has often been found impossible to restore life; and indeed the period at which resuscitation may take place, will vary in different subjects according to circumstances. Supposing the hanging to be unattended with violence to parts about the neck, it is possible that some individuals might be resuscitated after five minutes suspension or longer. Others again may not be recovered when they are cut down immediately after suspension,—a fact which depends probably on the different degrees to which asphyxia or apoplexy has extended. Venesection, cold affusion, and the application of ammonia and other stimuli, may be employed on these occasions. Besides, much will depend, as in drowning, upon the time at which assistance is rendered after the body has been cut down.

The following case of recovery, in which however asphyxia was not com-

plete, was reported in the Lancet, Nov. 1839. A robust woman, aged thirty-three, hung herself while slightly intoxicated. She was missed about ten minutes before she was found suspended to a bedstead, but how long she had been thus hanging it was impossible to determine. Medical assistance was rendered to her about ten minutes after she had been cut down. She was then quite insensible,—her respiration slow and laborious, and her pulse barely perceptible. The countenance was pale,—there was no lividity—the lower jaw was depressed,—the extremities were moderately warm, and the hands convulsively clenched,—the pupils were somewhat dilated, and barely susceptible of the stimulus of light. A dusky red mark of a quarter of an inch in breadth, was distinctly observed encircling the upper part of the neck, forming an angle over the ramus of the jaw on the right side, where the knot of the ligature (a silk handkerchief) had rested, and in consequence of this the constriction was incomplete. The patient was twice copiously bled, mustard sinapisms were applied to the calves of the legs, hot water to the feet, and cold applications to the head. After thirty-two ounces of blood had been abstracted in half an hour, the breathing became stertorous, the pupils fully dilated, the lower jaw fell further, the sphincters became relaxed, and the patient appeared to be rapidly sinking. Ammoniacal liniment was rubbed on the chest, and the woman so far recovered in an hour, as to be able to swallow: but although she was conscious of pain, she remained comatose until the evening, when she became perfectly sensible of surrounding objects. This was evidently a case of imperfect suspension where, from respiration still continuing, there was every hope of recovery. The cerebral circulation comes on under circumstances where it would not be generally ex-
had here become disordered. Persons may die indirectly from the effects of hanging. A man aged sixty, hung himself, was cut down and resuscitated. The breathing was stertorous, and he died in two days afterwards.

We learn from those who have been resuscitated, as well as from experiments performed by individuals upon themselves, that asphyxia comes on in the most insidious manner in death from hanging, and that the slightest constriction of the trachea will speedily produce insensibility. (Devergie, ii. 370.) The only symptoms of which the persons have been conscious, were a ringing in the ears, a flash of light before the eyes, then darkness and stupor. The only profitable inference in a medico-legal view which can be drawn from observations of this kind is, that asphyxia is not only very rapidly induced, but that it
pected to occur, the body of the individual being in great part supported. M. Fleichmann found that a cord might be placed round the neck, between the chin and os hyoides, and tightened either laterally or posteriorly, without perceptibly interrupting respiration : but while the respiratory process was thus continuing, the face became red, the eyes prominent, and the head felt hot. These symptoms were followed by a sense of weight, a feeling of incipient stupefaction, and a hissing noise in the ears. On the occurrence of this last symptom, the experiment should be discontinued or the consequences may be serious. The first experiment lasted two minutes, but in the second, the cord by its pressure more completely interrupting respiration, the noise in the ears appeared in half a minute. When the pressure was applied on the trachea, the effect was instantaneous, but on the cricoid cartilage it was not immediate. When it was applied between the os hyoides and the thyroid cartilage, or on the os hyoides itself, the period during which an individual could respire was extremely short; and this

result was more striking when the act of expiration was performed at the moment of applying the pressure.

The death of Scott, the American diver, in January, 1840, shows how very readily asphyxia is induced by slight compression of the throat, even where a person might be supposed to have both the knowledge and the power to save himself. This man was in the habit of making public experiments on hanging, and had frequently before gone through them without danger; but on this occasion, it is probable that a slight shifting of the ligature from under the jaw-bone caused sufficient compression on the throat between the chin and larynx, as speedily to produce asphyxia. No attempt was made to save him until it was too late, and he was not brought to an hospital until thirty-three minutes had elapsed. He was allowed to hang thirteen minutes—the spectators thinking that the deceased was only prolonging the experiment for their gratification! It is not improbable that many persons have thus lost their lives by attempting these experiments in private, and their cases have been wrongly set down as cases of suicide. There is, I think, no doubt that boys have thus frequently but unintentionally destroyed themselves.

Post-mortem appearances.—The following are the external characters of the body which are laid down as indicative of hanging by most medico-legal writers. Lividity and swelling of the face, especially of the lips, which appear distorted. The eye-lids are swollen and of a bluish colour;—the eyes red, projecting forwards, and sometimes partially forced out of the orbitar cavities;—the tongue enlarged, livid and compressed between the teeth, or frequently protruded. The lower jaw is retracted. A sanguineous froth exists about the lips and nostrils. There is a deep and ecchymosed impression around the neck, indicating the course of the cord, the skin being sometimes excoriated;—laceration of the muscles and ligaments in the hyoideal region;—laceration or contusion of the larynx, or of the upper part of the trachea. There are also commonly circumscribed patches of ecchymosis varying in extent about the upper part of the trunk and the upper and lower extremities, with a deep livid discoloration of the hands. The fingers are generally much contracted or firmly clenched, and the hands and nails are livid. The urine and fæces are sometimes involuntarily expelled at the moment of death. Internally we meet with the appearances described under the head of asphyxia. The right side of the heart and the great vessels connected with it, are commonly distended with blood. But when the inspection has been delayed for several days, this distension may not always be observed. The vessels of the brain are commonly found congested; and, in some rare instances it is said, extravasation of blood has been met with on the membranes and in the substance of the organ. Extravasation of blood is however so rare, that Remer found this appearance only once among one hundred and one cases; and in one hundred and six cases observed by Casper, it was not found in a single instance. The venous congestion of the cerebral vessels is rarely greater than in other cases of asphyxia.

In most instances there is increased vascularity of the substance of the brain, so that on making a section of the hemispheres a greater number of bloody points than usual, will appear. In addition to these morbid changes, a mucous froth, sometimes of a sanguineous hue, has been described to exist in the trachea; but this is only likely to be met with in cases in which the obstruction to respiration has been incomplete. A more important circumstance has been noticed by Dr. Yelloly, namely, that in examining the stomachs of five criminals who had been hanged, he found great congestion in all; while there was blood extravasated and coagulated upon the mucous membrane in two. Such an appearance might, it is obvious, be attributed to the action of some irritant substance in a suspicious case.

The account here given of the external post-mortem appearances has been chiefly derived from the examination of the bodies of executed criminals. These well-marked characters are not generally met with in cases of suicidal hanging; and therefore it will be proper to state what are the principal differences. Thus, the face is sometimes pale—a condition commonly seen in those cases in which there has been but little obstruction to the cerebral circulation, either from the softness or looseness of the ligature. Esquirol found in one instance, that when the body was examined immediately after death, the face was not livid; but it first began to assume a violet hue in eight or ten hours. He thought that when the cord was left round the neck, the face would be livid, but, if removed immediately after suspension, pale. This view is not, however, borne out by observation.

The tongue is not always protruded. Devergie found that there was protrusion of this organ, only in eleven cases out of twenty-seven. This protrusion was formerly supposed to depend upon the position of the ligature:—thus it was said when this was below the cricoid cartilage, the whole of the larynx was drawn upwards, and the tongue carried forwards with it, while, when above the os hyoides, the tongue was drawn backwards. The protrusion or non-protrusion of the tongue does not depend upon any mechanical effect of this kind, but simply upon congestion; for it is occasionally met with thus protruding in cases of drowning and in other forms of asphyxia. Besides, it has not been found to have any direct relation to the position of the ligature.

The most striking external appearance, however, is the mark produced by the ligature. The skin is commonly depressed and sometimes ecchymosed, but rarely throughout its whole extent: it is very frequently free from all traces of ecchymosis, the skin in the depression being then hard, brown, or of a parchment colour and consistency. The course of the mark is generally oblique, being lower in the forepart than behind. If the noose should happen to be in front, the mark may be circular, the jaw preventing the ligature from rising upwards in the same degree before, as it commonly does behind. The mark is generally single, but we may meet with it double, as where the ligature has been formed into two circles or loops previously to its application. Its other characters will depend upon the nature of the ligature employed. Thus a large and wide ligature rarely produces ecchymosis,—the mark is wide and superficial, but a small ligature produces a narrow and deep depression, sometimes accompanied with laceration of the cuticle and effusion beneath the skin. From the statistical researches of Devergie and Casper, it would appear that a cord or rope is employed in more than one-half of all the cases of hanging which occur. In other cases various articles of dress were found to have been employed. Medical jurists have considered it proper to examine into the position of the ligature, as this may sometimes form a question in cases of suspected murder by hanging. The following table will show that in more than two-thirds of all cases of suicidal hanging, the ligature is found encircling the neck between the chin and os hyoides.

	Remer.	Devergie.	Casper.
Above the larynx	38	20	58
On the larynx	7	7	9
Below the larynx	2	1	0
	47	28	68

It was formerly believed, that the impression produced by the cord was invariably ecchymosed, but more correct observation has shown that this is probably the exception to the general rule. When ecchymosis does exist, it is commonly superficial and of very slight extent. There is rarely if ever effusion of blood in the cellular tissue. In individuals who have been criminally executed, it is not unusual to find ecchymosis, but even here it is not always present. In a case which I had an opportunity of examining some years since, there was only a slight trace of ecchymosis in one spot where the knot in the cord had produced contusion. That it should commonly occur in criminal executions, is not surprising, considering the violence employed on these occasions; but it has been somewhat too hastily assumed that these appearances in executed criminals, are met with in all cases of death from hanging. This doctrine has been carried so far, that a livid mark in the course of the cord has been pronounced to be the best criterion for distinguishing hanging in the living, from hanging in the dead body. It will be seen hereafter, that this appearance cannot be relied on. In fifteen cases examined by M. Klein, in twelve examined by M. Esquirol, and in twenty-five cases of suicidal hanging which occurred to M. Devergie, there was no ecchymosis whatever in the course of the ligature, (ii. 394.) Out of six cases, Fleichmann met with only one instance. In three cases of suicidal hanging which I have had an opportunity of examining, no ecchymosis had been produced by the ligature. In all of these instances, the skin, instead of being blue or livid, or presenting effusion of blood in the cellular tissue beneath, was hard and of a yellow colour resembling parchment. It had that appearance which the cutis commonly assumes, when the cuticle has been removed from it for two or three days; and on dissecting it off, the cellular membrane beneath often appears condensed and of a silvery whiteness. In some instances the mark, instead of being livid or brown, has presented itself simply as a white depression. This has been observed in very fat subjects. The observations of Casper on this point are as follows. Out of seventy-one cases, there was no ecchymosis produced by the cord in fifty; and thus in two-thirds of the cases examined, it was entirely absent. Casper also found that there was no difference in the result, whether the ligature were removed sooner or later after death. The following singular case which occurred to Dr. Hinze, of Waldenburg, will also show that the presence of ecchymosis in the mark, does not depend on the ligature being left around the neck.

A young man in a fit of drunkenness hung himself with a stout cord. In about half an hour afterwards, he was cut down, and attempts were made to resuscitate him. It was perceived that the cord had merely produced a superficial impression on the neck, destitute of all appearance of ecchymosis. Signs of returning life began to manifest themselves:—the attempts at resuscitation were continued for several hours, but all signs of vital reaction disappeared: and now, when life was about to become again extinct,—to the astonishment of all present, the mark on the neck which had been hitherto colourless, became deeply ecchymosed. On an inspection being made the next day, it was found that this ecchymosis continued; and that it was owing to a real subcutaneous effusion. From the appearances in the head, it was concluded that the deceased had died from congestive apoplexy.

It should be mentioned that Remer considers ecchymosis in the course of the cord to be a frequent appearance in hanging; but Devergie objects to the inference which he has drawn from his cases. (ii. 397.) Injuries to the muscles and deep-seated parts of the neck are of course only likely to be seen, where considerable violence has been used in hanging. In one or two instances, the lining membrane of the common carotid artery has been found lacerated.

Congestion and tumefaction of the genital organs in either sex have been set down among the common consequences of hanging,—but many observers have never met with these conditions; and it is doubtful whether, unless the body be examined speedily after suspension, any marked difference would be discovered. A more common sign perhaps is the discharge of the spermatic secretion in the male;—but according to Casper, it is the mucous secretion of the prostate gland, which is thus discharged at the moment of death taking place from hanging. He states that traces of this are met with in from one-third to one-fourth of all cases of death from hanging in the male. Very little reliance can be placed upon evidence derivable from this sign, and yet it has sufficed to give rise to a violent controversy among French medical jurists. (Ann. d'Hyg. 1839, i. 168 et seq.) Unless death from hanging be pretty strongly borne out by other facts, neither the examination of the linen of the deceased, nor the application of the microscope to the mucous fluid found in the urethra, will be of any practical value in elucidating the question.

The following may be taken as a summary of the post-mortem appearances. The countenance is livid or sometimes pale, the eyes are prominent, the tongue congested, and occasionally protruded, the lower jaw retracted :—the skin is covered with patches of cadaverous ecchymosis, the hands are livid and clenched, an oblique mark is found on the neck,—sometimes presenting traces of ecchymosis, commonly, however, the skin is only brown in colour and hardened. The larynx, trachea, and subjacent muscles are lacerated, depressed, or discoloured. The vessels of the brain are congested, as well as those of the lungs and the right cavities of the heart. A mucous froth is occasionally found in the trachea.

WAS DEATH CAUSED BY HANGING?—When a person is found dead and the body suspended, it may be a question whether death really took place from hanging or not. In investigating a case of this kind, it is necessary to draw a distinction between the external and internal appearances of the body. The former alone can assist us in returning an answer to this question,—the internal appearances of the body can only enable us to say whether any latent cause of death existed or not.

Neither the state of the countenance or skin, nor the position of the tongue, can afford any evidence on the subject of death from hanging. It is to the mark produced by the cord on the neck, that medical jurists have chiefly looked for the determination of this question. The form, position, and other characters of this mark having been already described, it will be only necessary to allude to it, as furnishing evidence of life at the time of its production. It has been stated, that so far from being constantly livid or ecchymosed, this condition is in reality not seen in more than one half of the cases which occur. But admitting that we find ecchymosis in the course of the ligature,—are we always to infer that this must have been applied while the individual was living? According to the experiments of Devergie, it would appear that if a subject be hanged immediately, or a short time after death, an ecchymosed mark may be produced by the application of a ligature to the neck. (ii. 408.) If a few hours were suffered to elapse, so that the body had become cooled, no ecchymosis was produced by the ligature. Professor Vrolik, of Amsterdam, found that a slightly livid mark was produced on the neck of a dead body, which was suspended *an hour* after death. (Casper Woch. Feb. 1838.) Hence this condition of the mark in a body found dead, indicates either that the deceased must have been hanged while living, or very soon after the breath had left his body. It would be for a jury to decide between these two assumptions; and to consider why, when a man had really died from other causes, he should have been hanged in secrecy immediately after death.

That the presence of active life is not required for the production of ecchymosis by the cord, appears to be established by the case reported by Dr. Hinze, (see antè, p. 526.) The circumstance that an ecchymosed mark may be produced by suspending a recently dead subject, bears out the statement of Merzdorff—that it would be in the highest degree difficult, if not utterly impossible, to determine medically by an inspection of the body, whether a man had been hanged while living, or whether he had been first suffocated and hanged up immediately after death. In making this admission, it is proper to bear in mind, that that which is difficult to a conscientious medical jurist, is often very easily decided by a jury from the general evidence afforded to them.

Sometimes besides ecchymosis, there are excoriations of the skin in the course of the cord; and these are known to be vital by the effusion of blood, for Devergie never met with this appearance in the dead even where the hanging took place immediately after death. The discovery of effused coagula in or about the deep-seated layers of the neck,—the larynx or trachea or in or about the spinal column, would render it very probable that the deceased must have been hanged while living. Such marks of violence are, however, rare in cases of hanging; and when they are found, it might be assumed that the effusion and coagulation of blood had been caused by violence offered to the neck immediately after death; but this assumption may be met by the question already suggested, namely, why death by hanging should be simulated in the body of a person who was alleged to have died from another cause.

With regard to the other, or more common kind of mark in suicidal hanging, it can scarcely be said to furnish any evidence in relation to the question which we are here considering. The depression may be hard and brown, although it does not usually acquire this colour until some hours have elapsed after death; for it appears to depend simply upon a desiccation of the portion of skin which has been compressed by the ligature. Sometimes the upper and lower borders only of the depression, present a faint line of redness or lividity; and it is worthy of remark, that when the ligature presents any knots or irregularities, those portions of skin which sustain the greatest compression are white, while those which are uncompressed may be found more or less ecchymosed. It is in this way that the form of the ligature is sometimes accurately brought out. It may be remarked of these impressions produced by the cord, that the characters which they present are the same, whether the hanging take place during life or soon after death:—the appearances may be very similar in the two cases. The following experiments were performed by Casper.

1. A man, aged twenty-eight, was suspended an hour after death, by a double cord passed round the neck above the larynx. The body was cut down and examined twenty-four hours afterwards. Between the larynx and os hyoides, there were two parallel depressions about a quarter of an inch deep—the skin having a brown colour with a slight tinge of blue, and a leathery consistency—in certain parts it was slightly excoriated. There was no extravasation of blood beneath, but the muscles which had undergone compression were of a dark purple colour, and the blood-vessels of the neck were congested. The appearance of this subject was such, that any individual unacquainted with the facts, would have supposed, on looking at it, that the person had really been hanged while living. There was nothing to indicate that the hanging had taken place an hour after death.

2. The body of another young man was hanged an hour after death, and an examination was made the following day. The two depressions produced by the double cord were of a yellowish brown colour, without ecchymosis. The cutis appeared as if it had been burnt or cut, and felt like parchment.

3. An old man who had died from dropsy was hanged two hours after death. The impressions presented exactly the same characters as in the preceding case. (Wochensch. für die G. H. Januar, 1837.)

When the constriction took place at a later period after death, there was no particular effect produced. We learn from these experiments, as well as from those performed by other observers, that the mark which is most usually seen in vital hanging, (non-ecchymosed,) is also produced by a ligature applied to the neck of a subject within two hours after death,—consequently the presence of this mark on the neck is no criterion whether the hanging took place during life or after death. The changes in the skin beneath the mark, are also destitute of any distinctive characters: there is the same condensation of the cellular membrane whether the hanging have occurred in the living or dead. These changes are the simple result of a physical cause,—mechanical compression.

Thus then we draw the conclusion that there is no distinctive sign by which the hanging of a living person can be determined from an inspection of the dead body. All the external marks may be simulated in the dead subject, and the internal appearances furnish no evidence whatever. Still, when the greater number of the signs enumerated are present, and there is no other satisfactory cause to account for death, we have strong reason to presume that the deceased has died from hanging. We must not, however, abandon medical evidence on these occasions, merely because plausible objections may be taken to it. Facts may show that, however valid such objections may be in the abstract, they are wholly inapplicable to the particular case under investigation. Perhaps the greatest medical difficulties occur in reference to cases of suicide, owing to the slight appearances which here attend this form of death; but on these occasions, moral and circumstantial proofs are so generally forthcoming, that even an inspection of the body is scarcely ever deemed necessary by a coroner. If then it be admitted by a medical jurist, that it is not in all cases possible to distinguish hanging in the living from hanging in the dead, the admission must be considered as having reference to cases, wherein individuals destroy themselves, and not to cases where they are destroyed by others. Even if a doubt were raised in any particular instance, it is more than probable that circumstantial evidence would furnish data for a decision, and thus satisfactorily make up for the want of ordinary medico-legal proof.

If when we find a deeply ecchymosed mark around the neck of a dead subject, we say, all other circumstances being equal, that the individual had most probably died by hanging, we shall not be departing from a proper discharge of our duty; since although it is medically possible that such a mark may be produced after death, yet as it would be only a murderer who would think of hanging up a recently dead body to simulate suicide, so it is certain, that in such a case we should most probably find some very obvious indications of another kind of violent death about the person. The absence of these, and the presence of ecchymosis in the course of the cord, would, it appears to me, leave the question of vital hanging decidedly settled in the affirmative. It is necessary that great caution should be used in expressing an opinion that the hanging probably took place after death, merely from the absence of ecchymosis in the seat of the ligature; because, while this is generally true, it may in particular cases lead to the concealment of the real mode of death. Many facts already adduced show that numerous cases of hanging during life, would be pronounced to be post-mortem, if this were taken as a criterion. The mere discovery of violence about the person is not of itself sufficient to rebut the presumption of death from hanging on these occasions. The violence at least should be of such a nature as to account for the immediate destruction of life, or it can throw no light upon the doubt whether the individual might not have died from hanging in spite of the marks of maltreatment about him.

If in the case of a person found hanging, a medical jurist should assert that death had not taken place from that cause, this would be tantamount to declaring that the deceased must have been murdered: —because it is impossible to admit that any but a murderer would hang up a recently dead person; and this has been frequently done for the purpose of concealing the real means of death and making the act appear to be one of suicide. The following case is reported by Deveaux.

A female was found suspended to a beam in a barn. From the absence of all the marks of hanging about the face and neck of the deceased, a careful examination of the body was made. In the course of the inspection, a small penetrating wound evidently inflicted by a round instrument, was discovered on the right side of the chest, but in great part concealed by the mamma of that side. On tracing this wound, it was found to pass between the fifth and sixth ribs, completely perforating the heart from the right to the left side. A considerable extravasation of blood had taken place internally, which had been the cause of death. It was therefore evident from the result of this examination, that the deceased had been killed, and her body suspended after death. For a precisely similar case by Prof. Vrolik, see Casper. Woch. Feb. 1838. Foderé refers to a case in which an individual was found hanging under somewhat similar circumstances, and, on examination it was discovered that death had been caused by the administration of poison,—the body having been subsequently suspended. In one instance Devergie discovered a quantity of plaster of Paris in the stomach and intestines of a person found hanging.

There are cases in which some embarrassment may occasionally arise. It may be a question whether the discovery of poison in a person found hanging necessarily indicates that death was due to poison. Death by hanging is not incompatible with previous attempts at suicide by poison. An individual has even been known to hang himself after or about the time that he had swallowed a strong dose of prussic acid. (See case, antè, p. 256.)

Circumstantial evidence has more than once assisted in clearing up a doubtful case. Louis states that on removing the body of a man who was found hanging, the rope was observed to be clotted with blood. This simple circumstance led to further investigation, by which it was discovered that the person had been murdered, and his body afterwards suspended. The presence of marks on the neck indicative of strangulation, such as the cord was not likely to have produced, may lead to a suspicion that the hanging followed death.

In April 1829, a boy was found hanging perfectly dead. On inspecting the body a round ecchymosed mark, about the size of a dollar, was seen on the fore part of the neck, and near it, were several impressions as of fingers in the surrounding skin. There was neither depression nor ecchymosis in the course of the cord. The inspection left no doubt that the deceased had died from asphyxia. It was subsequently discovered, that the boy had been first strangled and afterwards hanged.

In another case a man was found hanging in a room. His body was so suspended from a hook in the door, that the trunk was not more than nine inches from the floor; and his legs were stretched out at length. The cord was from two to three feet long, and but loosely passed round the neck. The furniture of the room was in great disorder, and some marks of dried blood were seen on one part of the floor. The right side of the head and face of the deceased, presented several excoriated and ecchymosed marks. There was a circular impression around the neck produced by the cord; but it was entirely free from ecchymosis. On the left side, a little above this impression, there was a strongly ecchymosed mark, which could be traced round to the back of the head. Blood was found extravasated beneath this mark. The lungs presented the characters of asphyxia, but the examiners referred this to strangulation and not to hanging, considering that the body had been suspended after death to give the appearance of suicide. Had there been an ecchymosed mark on the neck, which could not have resulted from the suspending cord, the case would have remained medically speaking doubtful; because it is well known that the affirmative signs of hanging may be absent, and yet the individual may thus have died.

Marks of violence on the hanged.—The presence of marks of violence on the body of a hanged person, is important; and it will be proper for a witness to notice accurately their situation, extent, and direction. Having satisfied himself that they must have been received during life, he will have to consider the probability of their being of accidental origin or not. These marks of violence are not always to be regarded as unequivocal proofs of murder; for it is possible that they may have been inflicted by the individual himself before hanging, and not succeeding in committing suicide by these attempts, he may subsequently have resolved to accomplish his purpose by suspending himself. Let the witness duly reflect on these circumstances before he allows his opinion to implicate any party,—let him consider that a hanged subject may bear the marks of a gun-shot wound, his throat may be cut, his person lacerated or disfigured, and yet before a suspicion of homicide is allowed to be entertained, it ought to be clearly shown that such injuries could not, by any probability, have been self-inflicted. The importance of observing caution in such a case will be still more manifest, when there is no ecchymosis produced by the cord, and the face does not present the usual characters of hanging.

Marks of violence on a hanged subject, may in some cases be fairly ascribed to *accident.* If the individual have precipitated himself with any violence from a chair or table in a furnished apartment, he may have fallen against articles of furniture and have given rise to lacerations and contusions especially on the extremities. Again, it is possible to imagine with Dr. Male, that the rope may have given way, and the individual in falling, have injured his person; but he may afterwards have had resolution enough to suspend himself again. Such an occurrence may be rare; but when the presence of these injuries is made to form the chief ground of accusation against a party as the murderer, their accidental origin ought not to be lost sight of by a considerate witness. If we suppose the person to have been hanged in a state of intoxication or stupefaction, medical evidence alone will rarely suffice to determine the question of homicide or suicide. The absence of all marks of violence from the person might actually lull suspicion.

It is proper on these occasions to look to the hands of the deceased, since it is with these that a person defends himself, and unless taken unawares, it is almost certain if the hanging were homicidal, that there would be traces of violence on these parts. The clothes would be torn and discomposed, and the whole appearance of the deceased would be that of one who had done his utmost to resist a violent murderous attack. There are some injuries which could not be attributed to accident under the circumstances. Among these we may enumerate fractures, dislocations, deeply penetrating or incised, or gun-shot wounds. Now the question is, Do these serious injuries necessarily establish homicide? The answer must be in the negative:—although where fractures or dislocations exist, there are very strong grounds for suspicion. Suicides, it must be remembered, are capable of making many attempts on their lives by various means.

In the spring of 1836, a gentleman was found dead hanging in his bedroom at an inn. His dress was much disordered, and blood which had issued from a deep wound in his throat, was found scattered over the floor. From the facts proved, there was no doubt that this had been an act of suicide; and that the deceased, previously to hanging himself, had first attempted to cut his throat. Had his body been found in an exposed situation, this wound in the throat might have given rise to a suspicion of murder. For another and still more remarkable case, (see antè, p. 78.) An interesting case of this description will be found reported by M. Dégranges. (Ann. D'Hyg. 1835, ii. p. 410.) In one instance of suicidal hanging, there were lacerated wounds upon the head, and a handkerchief was found blocking up the mouth. (Henke's Zeitschrift, 1838, ii. 257; 1839, i. 207; also 1840, i. 135; also B. and F. Med. Rev. No. xxiv. p. 560.)

WAS THE HANGING THE RESULT OF ACCIDENT, HOMICIDE, OR SUICIDE?—Most medical jurists have passed over the subject of accidental hanging, probably believing it to be impossible. In the sense commonly implied by the term, it is certainly unusual, but although rare, it is a possible occurrence. Dr. Smith mentions a case which occurred some years since in which a girl of the age of thirteen, was hanged by pure accident. She was swinging in a brewhouse, and near the rope used by her for that purpose, was another for drawing up slaughtered sheep. In the course of the exercise, her head got through a noose of this second cord, which pulled her out of the swing and kept her suspended at a considerable height, until dead.

The following case was communicated to me by one of my pupils. In December 1833, an inquest was held on the body of a boy aged ten years. It appeared in evidence that he had been playing with a child eight years old, who was the only witness of his death. The deceased had been amusing himself in swinging, by fastening a piece of plaid gown to a loop in a cord which was suspended from a beam in the room. In the act of swinging he raised himself up, and gave himself a turn, when the loop of rope suddenly caught him under the chin, and suspended him until life was entirely extinct. The boy who was in the room with him, did not give any alarm for some time, thinking that the deceased was at play. The jury returned a verdict of "accidentally hanged." Another case occurred in London in 1836. A man who was in the habit of exercising himself in gymnastics on the rope, was one morning found dead and suspended in his bed-room. The rope had passed twice round the body and once round the neck, whereby it had caused death, although the legs of the deceased were resting on the floor. There was no doubt that the deceased had been accidentally hanged.

These are the only cases which have come within my knowledge, and it will be seen that the circumstances under which they occurred, were sufficiently decisive of the manner in which the hanging took place. Indeed circumstantial evidence must always suffice for the discrimination of accidental hanging; and we have therefore to inquire whether, when an individual is found hanging under circumstances which do not allow of the suspicion of accident, the act be the result of suicide or of homicide. The medical witness must remember that this is strictly a question for the jury. It is not for him to say whether a man has hanged himself or been hanged by others, but merely to state those medical circumstances which support or rebut one or the other presumption.

It has been very truly observed that of all the forms of committing murder, hanging is one of the most difficult, and it is, therefore, but seldom resorted to. In most cases where an individual has been hanged by others, it has been after death, in order to avert the suspicion of homicide. Hence the discovery of a person hanging, affords primâ-facie evidence of suicide, supposing it to be rendered probable if not absolutely certain, that death has taken place in this manner. We must, however, admit that an individual may be murdered by hanging, and the appearances about his body will not afford the smallest evidence of the fact. The circumstances which will justify a medical jurist in making this admission, are the following. First, where the person hanged, is feeble, and the murderer a strong healthy man. In such a case, a child, a youth, a female, or an individual at any period of life, worn out and exhausted by disease or infirmity, may be in this way murdered. Secondly, when the person hanged, although usually strong and vigorous, is at the time in a state of intoxication, stupefied by narcotics, or exhausted by his attempts to defend himself. Thirdly, in all cases, murder may be committed by hanging, when many are combined against one individual. With these exceptions, then, a practitioner will be correct in deciding in a suspected case, in favour of the presumption of suicide. Unless the person labour under stupefaction, intoxication, or great bodily weakness, we must expect in homicidal hanging, that there will be evident marks of violence about the body; for there are few who would allow themselves to be murdered without offering resistance, notwithstanding the assertion of Mahon, that some might submit to this mode of death with philosophical resignation, when they saw that resistance was hopeless.

The following singular case of attempted murder by hanging, is mentioned in Syme's Justiciary Reports, Edinburgh, 1827. A woman, aged sixty-nine, was charged with attempting to hang her husband, who was some years older. It appeared that the prisoner contrived to twist a small rope three times round the neck of her husband, while he was lying asleep. She then tied him up to a beam in the room, in such a manner, that when the neighbours entered he was found lying at length on the floor with his head raised about one foot above it. He was quite insensible,—his hands were lying powerless by his side;—his face was livid, and it was some time before he could be roused. Had he remained three minutes longer in this position, he would have died. According to his statement, he went to bed quite sober, and he was not aware of anything which passed during the attempt to hang him or afterwards, until he was resuscitated. The prisoner was convicted of the assault without previous malice, she having had no ill-will against her husband, and being at the time intoxicated. It can hardly be considered possible, that any man should be so sound asleep as not to be awakened by the attempt thus made to hang him. The probability is, that the prosecutor was like his wife, intoxicated.

Some medical jurists have thought that the mark left by the cord on the neck, would serve as a criterion on which we might depend. Thus it has been said, if the mark be circular and placed at the lower part of the neck, it is an unequivocal proof of murder. In hanging, the mark of the cord is generally oblique, being higher at the back part of the neck, in consequence of the loop formed by it, yielding more in that direction than anteriorly. But it is an error to suppose that this want of obliquity in the impression can afford any evidence in favour of the act having been homicidal. Its form will depend in a great degree upon the fact of the body being supported or not, for it is the weight of the body which causes its obliquity: it will also depend on the manner in which the cord is adjusted. A case of suicidal hanging, is related by Orfila in which the mark of the cord extended horizontally round the neck from behind forwards. (Méd. Lég. tome ii. p. 376.) The slip-knot of the cord was in front of the neck, and it is obvious that when the cord is thus adjusted by a suicide, there will be scarcely any obliquity in the depression produced by it. Equally ill-founded is the assertion, that the existence of two impressions on the neck, affords positive proof of homicide. One of these impressions, may be at the lower part of the neck and circular; the other at the upper part, and oblique;—it is therefore contended that the deceased must have been strangled in the first instance and afterwards hanged. The possibility of a prior attempt being made by a suicide to strangle himself is not adverted to,—"si l'on observe les deux impressions," says Mahon, "l'assassinat est alors parfaitement prouvé." It is fortunate that there are facts on record to oppose to this very decided statement. One of the first cases reported by Esquirol, is that of a female lunatic who committed suicide by hanging herself, and on whose neck, two distinct impressions were seen,—the one circular, the other oblique. These appear to have arisen from the circumstance of the cord having been twice passed round the neck,—the body being at the same time partially supported. In some instances, a presumption of homicidal interference may exist if there be two distinct impressions, but it cannot be admitted that they establish the fact of murder.

The injury done to the neck by the cord, can rarely afford any clue to the manner in which hanging took place, unless the circumstances under which the body is found, favour the presumption of homicide or suicide. Thus the laceration of the muscles and vessels of the neck, —the rupture of the trachea and the displacement of the larynx, may be observed in suicidal as in homicidal hanging. The presumption, however, is obviously in favour of the latter when these violent injuries are discovered, accompanied by fracture of the cervical vertebræ, and the body of the deceased is not corpulent,—the ligature, by which he is suspended is not of a nature to produce them, and the fall of the body has not been great. A much disputed question has arisen in medical jurisprudence,—whether the cervical vertebræ can become fractured or displaced in suicidal hanging. Most medical jurists deny the possibility of this accident occurring,—the displacement or fracture of these vertebræ being rarely observed even in criminal executions, where the greatest violence has often been used by the executioner. So far as I am aware, there is no case of suicide on record in which this injury to the neck existed. The case referred to by Petit, which was left to the decision of Dr. Pfeffer, is unsatisfactory, because the body was not examined, and it is doubtful whether the act had been one of suicide or not.

M. Ansiaux, of Liége, in inspecting the body of a woman who had hung herself, found extravasated blood behind the two first cervical vertebræ, which were more widely separated posteriorly than usual. On removing the vertebræ, the posterior ligament of the spine was found ruptured, and the transverse ligament of the atlas so stretched that the odontoid process of the second vertebra was completely locked against the articular surface. The perpendicular and oblique ligaments were entire. The deceased was a stout healthy person,—when discovered, her body was suspended from a beam at the distance of about a foot and a half from the floor. She had evidently fallen with considerable weight. The case of this female will serve to show that severe injury to these deep-seated regions of the neck, may occasionally be met with in suicidal hanging.

In all doubtful instances, we should not lose sight of moral and circumstantial evidence. We should ascertain whether the individual had been previously disposed to commit suicide or not,—we should observe whether the doors and windows of the apartment be secured on the inside or on the outside,—whether the dress of the deceased be at all torn or discomposed, or his hair dishevelled,—lastly, whether the rope or ligature correspond to the impression seen around his neck. These points fall, it is true, more within the province of the officers of justice, than of a practitioner; but the latter is generally the first who is called to see the deceased, and therefore, unless such facts were noticed by him on his visit, they might often remain altogether unknown.

Lastly, it has been contended that the *position* of the body may serve to distinguish suicidal from homicidal hanging. This point was strenuously argued on the investigation which took place relative to the death of the Duke de Bourbon in 1830. According to the opinions of some of the witnesses on that investigation, if the body of a man be found in an inclined posture, or so suspended as that his feet are in contact with the floor, the idea of suicide by hanging is at once negatived,—we are rather to suppose that the person must have been otherwise destroyed, and his body afterwards placed in that position by his murderers. Here then we are called upon to admit that suicidal hanging is improbable, if not impossible, unless the deceased be found freely and absolutely suspended without any support. This very strong opinion, it will be seen, is not borne out by facts. In order that death should take place by hanging, it is not necessary that the body should be freely and perfectly suspended. Cases are of very frequent occurrence, where the bodies of hanged persons are found with the feet on the ground kneeling, sitting, or even in the recumbent posture. These are truly mixed cases of hanging and strangulation. I have now before me the reports of eleven cases of suicidal hanging or strangulation, which have occurred within the last few years. In three the deceased were found nearly recumbent, in four, in a kneeling posture, the body being more or less supported by the legs, and in four, the persons were found sitting. For many singular cases of this kind with plates, see Annales D'Hyg. 1831, p. 157; 1830 i. 186.) In one instance the deceased was found on his knees at the foot of the bed, with his cravat round his neck, the other end being thrown over the bed-rail, and then twisted tightly round his right hand.

Among the cases collected by Esquirol is the following. A patient in La Charité was found one morning hanging by a rope which was attached to the head of his bed. He had fastened this by a loop round his neck, but his body was so retained that when discovered he was on his knees by the side of his bed. There are one or two other similar instances related by the same author which I shall omit, and describe one that fell within my own knowledge. In 1832, at the west end of the town, a man was found hanging in his room with his knees bent forwards and his feet resting upon the floor. He had evidently been dead for some time, since cadaverous rigidity had already commenced. The manner in which this person had committed suicide, was as follows,—he had made a slip-knot with one end of his apron, (he was a working mechanic,) and having placed his neck in this, he threw the other end of the apron over the top of the door and shutting the door behind him, he had succeeded in wedging it in firmly. At the same moment, he had probably raised himself on tip-toe and then allowed himself to fall,—in this way he died. The weight of his body had apparently sufficed to drag down a part of the apron, for it seemed as if it had been very much stretched.

Remer found that out of one hundred and one cases of suicidal hanging, in fourteen, the body was either standing or kneeling, and in one instance it was in a sitting posture. Further evidence need not be adduced to show how unfounded is that opinion which would attach the idea of homicidal interference, to cases where a body is loosely suspended or in contact with any support. We ought rather to consider this fact as removing all suspicion of homicide ; for there are few murderers who would probably suspend their victims either living or dead without taking care that the suspension was complete. Besides, all such cases are readily explicable ;—thus if the ligature be formed of yielding materials or loosely attached, it will give way to the weight of the body after death, and allow the feet to touch the floor, which they might not have done in the first instance. If there is reason to believe that the body has not altered its position after suspension, we must remember the facility with which insensibility comes on, and the rapidity with which death commonly ensues in this form of asphyxia.

One or two other points are also worthy of notice in relation to this question. The hands or the legs, but more commonly the former, have been, on more than one occasion, found tied in instances of suicidal hanging. (Ann. D'Hyg. 1832, i. 419.) It has been gravely debated, whether it were possible for a person to tie or bind up his hands and afterwards hang himself. It is unnecessary to examine the ingenious arguments which have been urged against the possibility of an act of this kind being performed; since among many cases that might be quoted, two have occurred in the present year, in this metropolis, where the persons died from hanging,—the act was suicidal, and the hands were found tied in both instances with a silk handkerchief.

Again, it has been a debated question, whether corporeal infirmity or some peculiarity affecting the hands, might not interfere with the power of an individual to suspend himself. This question can only be decided by reference to the special circumstances of the case. In the case of the Prince de Condé, it was alleged that he could not have hanged himself, in consequence of a defect in the power of one hand,—it was said that he could not have made the knots in which the cravats by which he was suspended, were tied. Allegations of this kind appear to have been too hastily made in this and other instances. A determined purpose will often make up for a great degree of corporeal infirmity; and unless we make full allowance for this in suicide, we shall always be exposed to error in drawing our conclusions. Is blindness a bar to suicidal hanging? The answer is decidedly in the negative, not from theory but from actual facts; although some might be inclined to doubt whether a man labouring under such an infirmity, could really thus destroy himself. In February, 1837, an inquest was held in London, on the body of a blind man, who was found dead, hanging in an outhouse. The evidence left not the smallest doubt of his having committed suicide.

Connected with this, is the question how far weakness or infirmity from age may interfere with this form of suicide. Any form of suicide among young subjects is rare. Out of one hundred and ninety-eight suicides, observed by M. Esquirol, at the Salpêtrière, there were but two instances of subjects under fifteen years of age. (Ann. D'Hyg. 1836, ii. 400.) The youngest age at which I have met with a case of suicidal hanging, was in a boy of nine years who hung himself at Hampstead, in April 1837. The oldest age was a case, which occurred in May 1843,—in a woman of ninety-one.

In a former part of this chapter, it has been stated that asphyxia in hanging is very insidiously induced, so that although the individual may appear to have the power of easily rescuing himself, yet this is impossible. The transition from life to death in such a case, is as rapid as it is imperceptible. This will explain why persons so readily die from slight constriction of the trachea, when their bodies are partly supported either standing, kneeling, or sitting :—why also it is not necessary that the cord or ligature should be drawn tightly round the neck ; and lastly, why, as it has frequently happened, this form of suicide, should be committed in a room where other persons are present, but who are not aware that such an act has been perpetrated. This last circumstance has in more than one instance, given rise to an ill-founded suspicion of murder.

When an individual has obviously died by hanging and the presumption of suicide is rebutted, or the act itself denied by a medical witness, the only alternative is, that it must amount to murder. It is not possible to conceive that the act of hanging another, can ever admit of justification or excuse. When in the case of death from drowning or wounds, it be doubtful whether to refer death to suicide or homicide, the admission of the act having been homicidal, does not necessarily cut off all hope from the offender. The deceased may have been drowned or wounded accidentally, or he may have been drowned or wounded intentionally ; but under circumstances of great provocation. The act, therefore, may turn out to be a form of manslaughter. In hanging, however, the defence could never be that the act was accidental, nor is it possible to believe that the law would admit provocation as a justification for what must have been so deliberately done. The act itself, like poisoning, would be at once evidence of malice. With this knowledge then of what the absolute denial of suicide must lead to in a suspected case, a witness is bound to examine closely every medical presumption which can be construed in the least degree unfavourably to an accused party.

This chapter may be closed with an account of the case of the Duke de Bourbon or Prince de Condé, which a few years since excited the attention of the medical jurists of France and England. It involves many of the questions connected with the medical jurisprudence of hanging. For a full account of the case, see Ann. D'Hyg. 1831, p. 157.

On the 27th August, 1830, the duke was found suspended in his bed-room, at the Chateau of St. Leu. A procès-verbal was instituted the same morning, and from the evidence of the witnesses, as well as from the reports of the physicians and surgeons who examined it, a verdict was returned to the effect that the Duke had committed suicide in a fit of temporary insanity. This event did not excite much notice until the contents of his will were made public.

The deceased, it appears, had made his will in favour of the Baroness de Feuchéres, a female who had lived with him for some years, bequeathing to her the whole of his immense estates. The heirs of the deceased, thus finding themselves deprived of an expected inheritance, attempted to set aside the will, alleging that undue influence had been exercised over him. The cause came on for hearing before the Civil tribunal of Paris, in December 1831, and excited considerable attention, not so much in consequence of the dispute concerning the validity of the will, as of the question which was raised during the trial,—whether the Duke had committed suicide, or whether he had been murdered, and afterwards suspended in order to defeat the ends of justice.

The facts of the case were as follows. The deceased had partaken of the alarm which had diffused itself throughout France in consequence of the events of the Revolution of 1830. His most intimate friends declared that for some time previously to his death, his mind had been filled with the most gloomy forebodings, as to what this new order of things would bring about. On the morning of the 27th, his servant went as usual to his bed-room door about eight o'clock, but receiving no answer on knocking, he became alarmed. Madame de Feuchéres then accompanied the valet to the door of the room, which was fastened on the inside, and receiving no reply after calling to the Duke in a loud voice, she ordered it to be broken open. On entering the apartment, the body of the deceased was found suspended from the fastening to the top of the window-sash, by means of a linen handkerchief, attached to another which completely encircled the neck. The head was inclined a little to the chest,—the tongue protruded from the mouth,—the face was discoloured,—a mucous discharge issued from the mouth and nostrils,—the arms hung down,—the fists were clenched,—the extremities of both feet touched the carpet of the room, the point of suspension being about six feet and a half from the floor,—the heels were elevated and the knees half bent. The deceased was partly undressed, the legs were uncovered and had some marks of injury on them. Among other points of circumstantial evidence, it was remarked that a chair stood near the window to which the deceased was suspended, and the bed looked as if it had been lain on.

The medical witnesses who examined the body soon after its discovery, stated that they found it cold, and the extremities rigid, from which they inferred that the deceased had been dead at least eight or ten hours. This would have fixed the time of his death at midnight of August 26th or early on the morning of the 27th. The body underwent a second examination, a report of which was furnished to the legal authorities on the following day. Five medical men were present at the inspection, and they gave it as their opinion from the post-mortem appearances, 1st, that the deceased had died by hanging, 2ndly, from the absence of all marks of violence or resistance about the person or clothes and other facts, that he had destroyed himself. They considered that the contusion on one arm and the excoriations observed on both legs, must have arisen from the rubbing of these parts against the projecting rail of the chair near the window. The mark on the neck of the deceased, they described to be large, oblique and extending upwards to the mastoid process. General evidence was given to show that the deceased had meditated self-destruction, and had conversed about it with some of the witnesses. On the morning of the 28th, some fragments of paper which had been written on, were taken from the grate of his chamber: these were carefully put together by one of the legal inspectors, and among a few disjointed sentences indicating despair and a dread of impending danger, were the following. "It is only left for me to die in wishing prosperity to the French people and my country. Adieu for ever." Here followed his signature, and a request to be interred at Vincennes, near the body of his son, the Duke d'Enghien. It is necessary to observe that no noise or disturbance was heard in the bedroom on the night of the deceased's death.

On the other side, it was contended that the deceased was not unusually melancholy before his death,—that the supposition of suicide was inadmissible in a moral point of view; and was physically impossible from the circumstances. One person argued that he could not have made the knots seen in the handkerchiefs,—another that he could not have reached so high above his head to have suspended himself, and that the chair could not have been used in any maner to assist him: while a third affirmed that a person might be suspended in the position in which the body was discovered, without death ensuing. The circumstance of the door being fastened on the inside, was accounted for by supposing that the bolt had been pushed to from the outside. The deceased had been heard to condemn suicide, he had made an appointment the following day, and had attended to many little circumstances, such as winding up his watch the night previously, and noting his losses at play,—facts which were forcibly urged as being opposed to the supposition of his having destroyed himself. To combat the medical evidence, it was assumed that the deceased was strangled or suffocated, and was afterwards hanged by assassins. Several schemes were devised by the medical witnesses on this side of the question, to account for the manner in which the supposed murder was committed. According to some, a handkerchief might have been tightened round the deceased's neck by one assassin, while another forcibly held his legs under the bed-clothes, by which the lesions already described would have been produced;—or instead of being strangled by a handkerchief, he might have been suffocated by a pillow placed over his mouth. The body might then have been dragged across the room to be suspended, and if during this time, the hand of one of the assassins had been rudely thrust between the cravat and the neck, the excoriation, and mark seen on the skin mght be easily accounted for. The counsel for the appellants remarked that the want of a line in writing to withdraw from all suspicion, his attendants, was remarkable, as this latter precaution had suggested itself to almost every suicide! He condemned those engaged in the anatomical examination of the body, as having been guilty of culpable mismanagement. He ridiculed the idea that the deceased, as reported by the two physicians consulted, had probably come to his death through asphyxia by strangulation. He contended that all the appearances on the skin of the neck, where no ecchymosis, *as is usual in persons hung alive*, was visible, showed *that death had preceded the hanging of the body.*

Such is an outline of this very singular case. Upon considering the facts and not the suppositions, which were adduced during the investigation, we can hardly fail to draw the conclusion that the deceased committed suicide. It clearly appears from the evidence of those who first inspected the body, that death was caused by hanging. It is true that some of the witnesses pronounced this to be impossible, because the body was nearly in contact with the floor, and no ecchymosis was apparent in the impression produced by the ligature, as well as for other circumstantial reasons which need not here be recapitulated; but these witnesses were for the most part uninformed persons, whose opinions respecting the possibility of such an occurrence, were not for a moment to be placed in opposition to those of the experienced medical examiners. The chief medical witness for the plaintiffs, urged that death might have been caused by strangulation or suffocation, while the deceased was lying in bed; but setting aside the circumstances which refuted this opinion, there were no facts to support it; and on the other hand, there was nothing, medically speaking, opposed to the belief that death had ensued from hanging. The dress was not discomposed; there were no marks of violence about the person; and it was not shown by the medical witnesses on this side of the question, that the excoriations on the legs could not possibly have had an accidental origin. Besides they do not appear to have considered that the deceased might have made repeated attempts before he succeeded in suspending himself, and in these attempts, have received the injuries. The absence of ecchymosis from the course of the ligature, and the position of the body, prove nothing whatever against death by suspension; while all the appearances of the body itself must tend to convince an unprejudiced mind, that this was really the manner in which the deceased died. If we feel fully satisfied from a consideration of these simple medical facts, that death was caused by hanging, we shall have less difficulty in admitting that the hanging was suicidal; we may, perhaps, best establish this by observing into what admissions we should be led, by adopting a contrary supposition. Hanging, as it has been already stated, is a very unusual form of committing murder,—the individual, with the few exceptions mentioned, has it in his power to resist this description of violent death more than most other kinds. Now, although the deceased was old and infirm, yet we can scarcely conceive that his infirmities were so great as to have rendered him wholly incapable of resisting the murderous attempts of these assassins; but on the supposition that this was an act of murder, we must imagine that he did not offer any resistance,—that he quietly walked across the room to be hanged; for we cannot but consider it clearly established by the evidence, not only that he died by hanging, but that he died where his body was found. We must further presume, that in moving from his bed, he neglected to ring a bell which was near the bed-side, and which would have sufficed to alarm his attendants; that his assassins tied the handkerchiefs together by a very curious and intricate knot, which the deceased from infirmity was incapable of tying, that they then adjusted his bed, and placed a chair by the side of the body, and left the room, drawing back the bolt on the outside by a spring, with which they had previously provided themselves; we are called upon to admit, that all these proceedings were carried on without any noise or disturbance by which some of the members of the household might have been roused!

The moral evidence was decidedly in favour of the commission of suicide, nor does the admission of the facts that the deceased had some time previously spoken against self-destruction—that he had made his memoranda the night preceding his death—wound up his watch, &c. at all militate against the presumption of self-destruction: for the histories of suicides abound in incidents of this kind. A man may form the resolution to destroy himself at one moment,—he may abandon it the next; but again a sudden impulse may subsequently induce him to put his original intention into execution. The great moral shock which must have been caused to all the members of the royal family in France, on the occurrence of the revolution of 1830, was by no means unlikely to prey upon the mind of the deceased, and lead to the commission of the crime; but whether this will explain the fact or not, the moral evidence adduced against it, does not affect the question, since we can only imagine the deceased to have been murdered by having recourse to a tissue of improbabilities. An attempt has been made to explain the circumstances of this case, by supposing that the deceased hung himself without intending self-destruction, but merely for the sake of enjoying a certain degree of pleasure, which, according to some, is experienced on the access of this species of asphyxia. What his intentions may have been, it is impossible to say, but the medico-legal questions connected with his death are:—First, whether he died by hanging; and secondly, whether, if so, he hanged himself or was hanged by others. Therefore, they who admit this singular explanation, admit all that is required to be proved.

The cause was decided against the appellants, and the president observed in summing up, that the charge of murder had been twice proved to be unfounded by judiciary proceedings. Every medical jurist must regret, that personal and political feelings were allowed to become so much mixed up with this important investigation. Popular prejudice went with the cause of the appellants; for it is notorious that the vulgar are ever ready to believe, on the death of a king, a prince, or a duke, that there must have been some criminal interference. If we admit that the medical facts in this case, justified a charge of murder, it is positively certain that nine cases out of ten of suicidal hanging, might be successfully disputed on the same grounds.

STRANGULATION.

CHAPTER LIII.

Hanging and strangulation are usually treated together, and some medical jurists have admitted no distinction in the meaning of these terms. In hanging, the phenomena of asphyxia take place in consequence of the suspension of the body, while in strangulation, asphyxia may be induced not only by the constriction produced by a ligature round the neck independently of suspension, but by the simple application of pressure through the fingers or otherwise to the trachea. It may indeed be said, that every individual who is hanged, is literally strangled ; but hanging is only one form of strangulation, and sufficiently peculiar to claim a separate consideration. We have now, therefore, to direct our attention to the other means which have been employed to obstruct the respiratory process by external pressure on the trachea. These have commonly been arranged and treated of under the head of manual strangulation.

The cause of death is the same in the two cases, and the rapidity with which death ensues in strangulation, will depend in a great degree on the force employed, and on the completeness with which the respiratory process is obstructed. In strangling, a much greater degree of violence is commonly employed than is necessary to produce asphyxia ; and hence, the marks produced on the skin of the neck, will be, generally speaking, much more evident than in hanging, where the mere weight of the body is the medium by which the trachea is compressed.

The post-mortem appearances externally and internally are the same in strangulation as in hanging, but the injury done to the parts about the neck, is commonly greater in the former case than in the latter. If much force have been employed in producing the constriction, the trachea, with the muscles and vessels in the fore-part of the neck, may be found cut or lacerated and the cervical vertebræ may be fractured. The mark of the ligature, if a ligature has been used, is generally circular and situated at the lower part of the neck. Instances have, however, been related where a circular mark has been observed in hanging ; and it is possible that some degree of obliquity may occasionally exist in the course of the depression produced by a ligature in strangulation. The medical jurist ought, therefore, to weigh all the circumstances connected with the position of the body and the direction of the ligature, before he forms an opinion as to whether the individual has been hanged or strangled. Much more importance is to be attached to the lividity, ecchymosis and abrasion of the skin in the course of the ligature, than to the circularity or obliquity of the depression produced by it. In the strangling of a living person by a cord, it is scarcely possible that a murderer should avoid producing on the neck, marks of violent injury ; and in the existence of these, we have an evidence of the manner in which death has taken place, which we cannot always expect to find in hanging. On the other hand, a person may be strangled, and yet the ligature, in consequence of its being soft and of a yielding nature, will not cause a very perceptible depression or ecchymosis. Such instances must, of course be rare ; because murderers usually produce a much more violent constriction of the neck than is necessary to ensure the death of their victims.

The medico-legal questions relative to strangulation, are of the same nature as those which have already been discussed in treating of hanging. Thus, in examining the body of a person, suspected to have been strangled, we may be required to answer the following question :

WAS DEATH CAUSED BY STRANGULATION, OR WAS THE CONSTRICTING FORCE APPLIED TO THE NECK AFTER DEATH ?—The internal appearances of the body will yield no evidence, whereby the question can be solved ; but the external appearances are commonly less ambiguous, than in a corresponding case of hanging. The ecchymosis about the depression on the neck, when a ligature has been employed, with the accompanying turgescence and lividity of the face, are phenomena not likely to be simulated in a dead body by the application of any degree of violence. When the constriction is produced within a few minutes after dissolution, an ecchymosed depression may result ; but it is improbable that there should be any lividity or turgescence of the countenance. Casper's experiments have established, that when the constricting force is not applied until six hours after death, no mark resembling that formed on the living subject, is produced. It is difficult to conceive under what circumstances such an attempt to simulate strangulation in a recently dead body, could be made, unless for the purpose of throwing suspicion upon an innocent person connected with the deceased. When an individual has been murdered, it is not likely that the murderer would attempt to produce the appearances of strangulation on the body after death, under the idea of concealing his crime ; for strangulation is in most cases a positive result of homicide, and is very rarely seen as an act of suicide. In the absence of ecchymosis from the neck, it will be difficult to form an opinion unless from circumstantial evidence. It must be remembered, however, that there may not always be an ecchymosed circle, for an individual may be strangled by the application of pressure to the trachea through the medium of the fingers or of any hard or resisting material. The ecchymosis in such a case will be in detached spots.

In the absence of all marks of violence about the neck, we should be cautious in giving an opinion which may affect the life of an accused party ; for it is scarcely possible that homicidal strangulation could be accomplished without the production of some appearances of violence about the larynx or trachea. The medical witness should be prepared to consider whether in such a case, death might not have proceeded from another cause, and leave it to the authorities of the law, to decide from circumstances in favour of, or against the prisoner. There is, I conceive, nothing to justify a medical witness in stating that death has proceeded from strangulation, if there should be no appearance of lividity, ecchymosis, or other violence about the neck or face of the deceased. The state of the countenance alone, will scarcely warrant the expression of an opinion; for there are many kinds of death in which the features may become livid and distorted from causes totally unconnected with the application of external violence to the throat. Let not a witness, then, lend himself as an instrument in the hands of a counsel for the condemnation of a person against whom nothing but a strong suspicion from circumstances may be raised, and where medical evidence is unable to throw any light upon the probability of death having resulted from strangulation. See the trial of Mrs. Byrne, for murder, Dublin Commission Court, Aug. 1842. This trial is full of interest to the medical jurist. Some post-mortem changes appear to have been mistaken for marks of strangulation.

WAS THE STRANGULATION THE RESULT OF ACCIDENT, SUICIDE, OR HOMICIDE?—Cases of accidental strangulation are by no means uncommon. They have occurred from individuals carrying weights at their backs, supported by bands passing round the head or chest, the slipping of which has given rise to asphyxia, by compressing the trachea. In all cases of accidental strangulation, the position in which the body is found, as well as other points of circumstantial evidence, must suffice to establish unequivocally the manner in which death really took place. When a charge of murder is instituted against a party, an attempt is not unfrequently made by the counsel for the defence, to show the probability that the deceased might have fallen in a state of intoxication; and have become accidentally strangled by a tight cravat, or by any foreign body exerting pressure on the trachea. If we admit the possibility of an occurrence of this nature, we must not lose sight of the existence of other more probable modes of death, nor should we allow our judgment to be so swayed as to abandon what is probable for that which is merely possible.

Suicide by strangulation must be regarded as of extremely rare occurrence, and except under particular circumstances, impossible. The possibility of an individual strangling himself, was for a long time denied by medical jurists; for it was presumed that where the force was applied by the hand, all power would be lost so soon as the compression of the trachea commenced. This reasoning, which is physiologically correct, is, however, only applicable to those cases in which the trachea is compressed by the fingers. When an individual, determined on suicide, allows the trachea to become compressed by leaning with the whole weight of his body on a ligature passed round his neck and attached to a fixed point, he may perish in this way almost as readily, as if he had hanged himself; for insensibility and death will soon supervene. In the chapter on hanging, it was stated that suicides were often found with their bodies in close contact with the ground, and cases were referred to in which strangulation was accomplished in the manner above described, while the suicide was in a sitting or kneeling posture. On other occasions, the peculiar disposition of the ligature has enabled a suicide to strangle himself without much difficulty. An instance is related by Orfila, where two cravats, which were twisted several times round the neck of the deceased, who was discovered lying on his bed, had effectually served the purpose of self-destruction. (Méd. Lég. iii. p. 389.) Other cases are related where suicides have succeeded in strangling themselves by tightening the ligature with a stick; or where this was formed of thick and rough materials, by simply tying it in a knot. (Ann d'Hyg. 1829, 440.) There are but few instances in which suicidal strangulation can be admitted to take place; and it would require a great deal of art and contrivance on the part of a murderer, so to dispose the body of his victim, or to place it in such a relation to surrounding objects, as to render the suspicion of suicide probable. Thus, if the ligature should be found loose or detached,—if the ecchymosis or depression should not accurately correspond to the points of greatest pressure,—if moreover, the means of compression were not very evident when the body was first discovered, and before it had been removed from its situation, there would be very fair grounds for presuming that the act was homicidal. In all those cases, where the strangulation has resulted from compression of the trachea by the fingers, and where there are fixed ecchymosed marks, indicative of direct manual violence, we have the strongest presumptive evidence of murder; for neither accident nor suicide could be urged as affording a satisfactory explanation of their presence. For a case of suicidal strangulation, see Brit. and For. Med. Rev. xiii. 261.

Strangulation does not often come before our courts of law as a question of murder: and when a party has been tried upon a charge of this kind, the circumstances have been commonly so clear, as to have rendered the duty of a medical witness one of a very simple nature. Difficulties do, however, occasionally, arise, as may be seen by reference to the cases of the Queen v. Taylor, York Lent Assizes, 1842, and the Queen v. Greek, Salisbury Lent Assizes, 1843. See also the important case of the Queen v. Reynolds, Central Criminal Court, December 1842. Here it was left uncertain by the medical evidence, whether death was due to strangulation or malicious exposure to cold, and as the indictment only charged the former act, the prisoners were acquitted. See likewise the case of the Queen v. Fowles, Stafford Lent Assizes, 1841.

SUFFOCATION.

CHAPTER LIV.

CARBONIC ACID. CHARCOAL AND COAL VAPOUR.

When the respiratory process is impeded by any cause which operates independently of external pressure on the trachea, the individual is said to perish by suffocation. The circumstances under which suffocation may be induced are very numerous. Thus, a diseased state of the parts about the fauces,—the sudden bursting of a tonsillary abscess, the effusion of lymph into the trachea or about the rima glottidis,—the presence of foreign bodies accidentally or forcibly introduced into the mouth,—may become so many causes of the sudden arrest of the respiratory function, the precise nature of any of which, a very superficial examination of the body will suffice to determine. Suffocation may be accidental or suicidal. Accidental deaths from this cause frequently occur from persons swallowing unusually large masses of food—from the deceased falling while intoxicated or helpless from infirmity into mud, feathers, ashes, or similar bodies. A singular instance of suffocation in a child, from a simple cause of this nature will be found in the Med. Gaz. xvii. 642. Suicidal suffocation from mechanical causes, is not very common, but some cases are recorded. A remarkable instance of this form of suicide is reported in the Ed. Med. Journal, April 1842. In this case the deceased forced a hard cotton plug into the back of the fauces. A similar case was the subject of an inquest in London, in September 1843. The deceased here had thrust into her throat, a large piece of rag, which had been used for a lotion. She speedily died suffocated, and after death the rag was found lodged at the back part of the larynx. The internal organs in these cases, present no particular appearance indicative of the kind of death; they are very liable to be mistaken for cases of apoplexy, and they certainly show the necessity for a post-mortem examination in every instance of sudden death. (See Ed. Med. Jour. liv. 149; also, Med. Chir. Rev. xxviii. 410.)

In a medico-legal point of view, asphyxia, induced by the operation of any of these causes of suffocation, is of far less importance, than that which is a consequence of the respiration of certain gases unfitted for the support of life; it is, therefore, chiefly to the effect produced on the system by these agents that we must direct our attention in treating of death by suffocation. The numerous gases with which chemists are acquainted, are found to vary materially in their operation when introduced into the lungs; and a division has been established among them into those which have a negative, and into those which have a positive action. The former alone can be considered to cause death by asphyxia or suffocation; for those which have a positive influence, must be regarded as poisons. Now experiment has shown that there are but two gases, which are essentially negative in their operation,—these are hydrogen and nitrogen; all the others have a poisonous action when introduced into the body. Indeed, with regard to hydrogen, some doubt may be fairly entertained respecting its claim to be considered as a truly negative agent; for the researches of Allen and Pepys in this country, and the observations of Wetterstedt in Sweden, have shown that this gas cannot be substituted for nitrogen in atmospheric air without inducing somnolency and lethargy. (Berzelius. Traité de Chimie, vol. vii. p. 106.) If, then, we admit that the greater number of the gases are poisonous, it is scarcely correct to regard these bodies as purely asphyxiating agents. The state of lifelessness which follows their introduction into the lungs, is not to be ascribed to the simple negation of air, as in the case of drowning, hanging, or strangulation; but to a deleterious impression produced on the system, something analogous in its effects to that which is observed to follow the ingestion of a poisonous dose of hydrocyanic or oxalic acid. The difference is, that the poison is aërial, and applied to the surface of the lungs instead of the stomach; but strictly speaking, a person is no more suffocated by carbonic acid, than he is by arsenuretted hydrogen. (See antè, p. 160.) Nevertheless, as the medico-legal history of these poisonous gases has nothing in common with that of poisons in general, they may be treated in the present chapter as suffocating media, according to the common view of their action on the body.

The greater number of these gases are never likely to be met with in the atmosphere so abundantly as to produce injurious consequences. They are chiefly complex products of art, and hence fatal accidents, arising from their inhalation, most commonly occur under circumstances which can leave no question respecting the real cause of death. The peculiar effects of all these, it will be unnecessary to describe; but there are two, a knowledge of the properties and operation of which, may on certain occasions be required of a medical jurist,—these are the Carbonic acid and Sulphuretted hydrogen gases. Agents of this description can scarcely be employed as instruments of murder; and if they were so employed, the fact could only be established by circumstantial evidence. Death, when arising from the respiration of either of these bodies, is generally attributable to suicide or accident. In France, it is by no means uncommon for individuals to commit self-destruction by sleeping in a closed apartment, in which charcoal has been suffered to burn; while in England, accidental deaths are sometimes heard of where coal has been employed as fuel in small and ill-ventilated rooms. On such occasions, a person may be found dead without any apparent cause to the casual observer,—the face may appear tumid and discoloured, and the cutaneous surface may be covered with ecchymosed patches. The discovery of a body under these circumstances, will commonly be sufficient, in the eyes of the vulgar, to create a suspicion of murder; and some individual, with whom the deceased may have been at that period on bad terms, will, perhaps, be pointed out as the murderer. In such a case, it is obvious that the establishment of the innocence of the accused party, may depend entirely on the discrimination and judgment of a medical practitioner.

An instance, illustrative of the consequences of this popular prejudice, occurred in London in the year 1823. Six persons were lodging in the same apartment where they were all in the habit of sleeping. One morning an alarm was given by one of them, a female, who stated that on rising she found her companions dead. Four were discovered to be really dead, but the fifth, a married man, whose wife was one of the victims, was recovering. He was known to have been on intimate terms with the female who gave the alarm, and it was immediately supposed that they had conspired together to poison the whole party in order to get rid of the wife. The woman who was accused of the crime was imprisoned; and an account of the supposed murder was soon printed and circulated in the metropolis. Many articles of food about the house, were analysed, in order to discover whether they contained poison, when the whole of the circumstances were explained by the man stating that he had placed a pan of burning coals between the two beds before going to sleep, and that the doors and windows of the apartment were closed. (Christison, p. 583.)

Carbonic acid.—This gas is freely liberated in respiration, combustion, and fermentation; it is also extricated in the calcination of chalk or limestone, and is abundantly diffused through the shafts and galleries of coal-mines, where it is commonly called choke-damp. Carbonic acid gas is likewise met with in wells, cellars, and other excavations in the earth. In these cases, it is found most abundantly generally on the soil or at the lower part of the well, and it appears to proceed from the decomposition of animal and vegetable matters confined in such situations. The slow evaporation of water strongly charged with the gas, while trickling over the sides of these excavations, may likewise assist in contaminating the air.

Symptoms.—The symptoms of poisoning by this gas, will vary according to the degree of concentration in which it is present in the atmosphere when respired. When it exists in a fatal proportion, the symptoms commonly observed, are as follows:—A sensation of great weight in the head—giddiness—a sense of constriction in the temporal regions—a ringing in the ears, with a pungent sensation in the nose; a strong tendency to sleep, accompanied by vertigo, and so great a loss of muscular power, that if the individual be at the time in an erect posture, he instantly falls as if struck to the ground. The respiration, which is observed to be at first difficult and stertorous, becomes suspended. The action of the heart, which on the first accession of the symptoms is very violent, soon ceases. Sensibility is lost, and the person now falls into a state of profound coma, or apparent death. The warmth of the body still continues; the limbs remain flexible, but sometimes they have been observed to become rigid, or even occasionally convulsed. The countenance is commonly of a livid or of a deep leaden colour, especially the eyelids and lips, but on some occasions, it is stated to have been pale. The access of these symptoms has been sometimes accompanied by a pleasing sensation of delirium, while at others the most acute pains have been suffered. In some instances there appears to have been irritability of the stomach, for the affected person has rejected the contents of his stomach in a semi-digested state. They who have been resuscitated, have often felt pain in the head, or pain and soreness over the body for several days; while, in a few severe cases, paralysis of the muscles of the face has supervened on recovery.

POST-MORTEM APPEARANCES.—Externally, the whole of the body appears as if it were swollen, especially the face, which is generally livid, and the features are much distorted. The cutaneous surface is covered in parts by patches of a violet hue, but in some instances the skin has been extremely pale; the eyes are generally prominent, and, in many cases, retain their usual brilliancy for some time after death. The body of an individual who has perished from the inhalation of carbonic acid, is said to retain the animal heat, cæteris paribus, for a longer period than usual; and hence cadaverous rigidity does not commonly manifest itself until after the lapse of many hours. In a case to be related presently, the body was however found to have cooled considerably in the short space of two hours. (p. 551.)

On making a post-mortem inspection, the venous system is found filled with blood of a dark colour, and the vessels of the lungs and brain are observed to be especially in a state of congestion. The tongue appears swollen, and it is stated by Orfila, that the mucous membrane of the intestinal canal is often interspersed with dark ecchymosed patches.

Some difference of opinion still exists respecting the manner in which carbonic acid acts on the body. Sir Humphrey Davy ascertained that carbonic acid, in a perfectly pure state, did not pass into the trachea, when an attempt was made to respire it; the glottis seemed to close spasmodically at the moment that the gas came in contact with it. On diluting the carbonic acid with about twice its volume of air, he found that he could breathe it, but it soon produced symptoms of vertigo and somnolency. In fact, in a diluted state, it is certain that it must penetrate into the lungs, or otherwise it would be impossible to explain why it should produce any other symptoms on the economy than those witnessed in the inhalation of hydrogen or nitrogen. The facts which have been collected by Dr. Christison, show, in a most striking point of view, that carbonic acid is a real and energetic poison of the narcotic kind. If, as Nysten supposed, it had a negative effect when respired, it ought to follow, that it might be substituted for nitrogen, in the proportion in which that gas exists in atmospheric air. But a mixture of carbonic acid and oxygen, in atmospheric proportions, has been shown by M. Collard de Martigny, to produce rapidly fatal effects upon the animal system. Such a mixture cannot be breathed even for a period of two minutes, without giving rise to serious symptoms

When the gas enters into the pulmonary cells, it is probably absorbed by the blood, and circulated with that fluid throughout the body. Its specific action on the brain may be inferred from the headache, vertigo, somnolency, and coma, which follow its introduction, as also from the loss of muscular power in persons labouring under its effects, and the paralysis which is sometimes seen in those who have recovered. A very small proportion of carbonic acid, when respired for a certain time in combination with air, will suffice to destroy life in man or in any of the higher orders of animals. It is generally admitted by physiologists, that an atmosphere containing more than one-tenth of its volume of carbonic acid will, if introduced into the lungs speedily prove fatal to human life. It is necessary, however, to make a distinction between the contamination of air from the admixture of free carbonic acid, and the case where the carbonic acid is formed by combustion or respiration in a close apartment, at the expense of the oxygen actually contained in air. Every volume of carbonic acid formed by combustion, indicates an equal volume of oxygen removed. Such an atmosphere is, cæteris paribus, more destructive than another where the air and gas are in simple admixture. If we assume that in each case the noxious atmosphere contains ten per cent. of carbonic acid, then in one instance there will be seven per cent. more of oxygen than in the other, as will be seen by the following tables:

	Free carbonic acid and air in admixture.	Carb. acid from comb. or respir. and air.
Nitrogen . . .	72	79
Oxygen . . .	18	11
Carbonic acid . .	10	10
	100	100

This difference in the proportions may not be, practically speaking, correct; because there is no apartment sufficiently closed to prevent air rushing in from the exterior, while combustion is going on within it; but, nevertheless, the above statement may be taken as an approximation to the truth.

When the gas is respired in the lowest poisonous proportion, the symptoms come on more slowly, and the transition from life to death is frequently tranquil ; this is what we learn from the histories of suicides. The symptoms in such cases appear to resemble closely those which indicate the progressive influence of opium, or any other narcotic poison on the body. The best means of resuscitation are the employment of cold affusion—with stimulating embrocations to the chest and extremities. If the surface be cold, a warm bath should be employed.

Charcoal vapour.—The gas extricated during the combustion of charcoal, according to the experiments of Orfila, is not pure carbonic acid, but a very compound mixture. It operates fatally when respired, chiefly in consequence of the carbonic acid contained in it, the proportion of which, however, is subject to variation, according to whether the combustion be vivid or not. When the charcoal burns vividly, the quantity of carbonic acid is less than when the charcoal is either nearly extinguished or beginning to burn. In the former case, the carbonic acid is in the proportion of about eleven per cent. by volume—in the latter, the proportion amounts to about fourteen per cent.; the remainder of the mixture is made up of air, of free nitrogen, and of a portion of carburetted hydrogen, if the charcoal be not too intensely ignited. (Orfila.)

The following case illustrating the effects of charcoal vapour, has been reported by Mr. Collambell. (Med. Gaz. xxvii. 693.)

In January 1841, a man was engaged to clean the windows of three small rooms on the basement story of a house. The first room had a door opening into a court-yard—the others merely communicated with each other by a central door, and there was no fire-place in any one. A brazier of burning charcoal had been placed in the outer room for the purpose of drying it, but it appeared that the deceased had shut the outer door and had removed the brazier into the inner room of the three, leaving the communicating doors open. In two hours, the man was found quite dead, lying on the floor of the middle room. The countenance was pale, as well as the whole of the skin; the eyes were bright and staring, the pupils widely dilated; the lips exsanguine; the jaw firmly fixed; the tongue protruding, and the face and extremities cold. Some frothy mucus had escaped from the mouth. The person who discovered the deceased, found the ashes in the brazier still burning, and he experienced great oppression in breathing. An inquest was held without an inspection, and a verdict of accidental death returned. The body was afterwards privately inspected by Mr. Collambell. On opening the head, the vessels on the surface of the brain were found highly distended with dark liquid blood: the pia mater was bedewed with serum. The brain was of unusually firm consistence, and numerous bloody points appeared on making a section of it. The lateral ventricles were distended with about an ounce and a half of pale serum, and the vessels of the plexus choroides were much congested. The cerebellum was firm, and presented on section numerous bloody points. About two ounces of serum, tinged with blood, were collected from the base of the skull. The lungs had a slate-colour. On the left side of the chest, there were eight ounces of serum tinged with blood, and nearly an equal quantity on the right side. On cutting into the organs, a large quantity of serous fluid, mixed with blood, escaped. The bronchial tubes were filled with a frothy fluid, tinged with blood. The pericardium contained an ounce of pale serum. The heart was enlarged; the cavities contained no blood. The liver and kidneys were much distended with blood. There was no doubt that the cause of death was the inhalation of carbonic acid; and it is probable that the man died from respiring but a comparatively small proportion. The capacity of the chambers must have nearly reached two thousand cubic feet; the man had been there only two hours, and when the person who discovered him, entered the rooms, the air was not so vitiated but that he could breathe, although with oppression. The fuel was then in a state of combustion.

It often excites surprise on these occasions that no exertion is made to escape, when it would apparently require but very slight efforts on the part of the individual. The fact is, that the action of carbonic acid is sometimes very insidious; one of its first effects is to create an utter prostration of strength, so that even on a person awake and active, as in the case just related, the gas may speedily produce a perfect inability to move or to call for assistance. For some good remarks on the action of charcoal vapour by Dr. Bird, see Guy's Hospital Reports, April 1839; and for a case illustrative of the dangerous effects of the diluted vapour, see Ed. Med. Jour. l. 541. In this instance, a charcoal brazier was left only for a short time in the cell of a prison. It was removed, and the prisoners went to sleep. They experienced no particular effects at first, but after some hours, two were found dead. Thus, then, an atmosphere which may be breathed for a short time with impunity, may ultimately destroy life.

COAL-VAPOUR.—The gases extricated in the smothered combustion of coal are of a compound nature. In addition to carbonic acid, we may expect to find in the atmosphere of a close room, in which such a combustion has been going on, sulphurous acid gas, and the sulphuretted and carburetted hydrogen gases. These emanations are equally fatal to life, but in consequence of their very irritating properties, they give warning of their presence, and therefore less liable to occasion fatal accidents. The sulphurous acid gas, when existing in a very small proportion in air, has the power of irritating the glottis so violently, that, if accidentally respired, it would commonly compel the individual to leave the spot before the vapours had become sufficiently concentrated to destroy life. Nevertheless, accidents from the combustion of coal sometimes occur.

The following cases will convey to the practitioner a knowledge of the symptoms and post-mortem appearances which are commonly met with on these occasions. A few years since, four individuals, in a state of asphyxia, were brought to Guy's Hospital. It appeared that on the evening before, they had shut themselves up in the forecastle of a coal-brig, and had made a fire. About six or seven o'clock the same evening, some of the crew accidentally placed a covering over the flue on the outside, and thus stopped the escape of the smoke from the fire, which was made of a kind of coal containing much sulphur. Early in the morning one of the crew, on opening the hatches, observed three of the inmates lying on the floor, senseless, and frothing at the mouth; the fourth in his crib, in a similar condition. The air in the place was most offensive. After the unfortunate persons were brought on deck, one of them, aged twenty-one, began to recover, and when brought to the hospital, seemed only giddy, as if intoxicated He soon completely recovered. Another, aged forty, after breathing oxygen gas, and having brandy and ammonia exhibited, scarcely showed any symptom towards restoration, and died in a few hours. A third, aged seventeen, soon began to rally, and, after a few hours, was perfectly enabled to answer any questions: he declared that he felt no pain, sense of oppression or weight, either in his head or chest. The fourth, aged fifteen, died the following day, having exhibited no symptom of rallying. Stimulants were administered internally, and warm fomentations were used, but all efforts to produce reaction failed. The appearance of the individuals, when brought in, was as follows:—lips purple, countenance livid, surface of the body cold, hands and nails purple, respiration very quick and short; pulse small, quick, and feeble; pupils fixed, and total insensibility. The body of the man, aged forty, was inspected about four hours after death. The membranes of the brain were congested, and there was a large quantity of fluid under the tunica arachnoides. The sinuses were gorged with blood. The lungs were in a state of great congestion, as also the right cavities of the heart. It was remarked, that this corpse was similar in appearance to that of an executed culprit. The body of the lad, aged fifteen, was inspected about thirty-three hours after death. Under the pia mater was observed one small ecchymosed spot; in the substance of the brain there were more bloody points than usual; a small quantity of fluid was found under the tunica arachnoides, and the sinuses were full of coagulated blood. The lungs showed no congestion, but the right cavities of the heart were much distended with blood. For an account of two cases of recovery from the effects of coal-vapour, see Med. Gaz. ix. 935.

It will be seen that there is nothing very characteristic in the post-mortem appearances, and thus it is always easy to ascribe death to apoplexy or some other cause; but it should be remembered that carbonic acid acts by inducing apoplexy or cerebral congestion. A stove was actually allowed to be patented a few years since—the principle of which was to allow of the escape of the products of combustion in an invisible form into an apartment. This led to the death of a man named Trickey, in St. Michael's church, in 1838, and many other serious accidents. The case of Trickey is in many respects worthy of the attention of the medical jurist. See Lancet, Nov. 1838.
no appearances upon which a medical opinion could be securely based.

In the burning of *lime*, carbonic acid is given out very abundantly and in a pure form. It has been owing to the respiration of the gas, thus extricated, that persons who have incautiously slept in the neighbourhood of a burning lime-kiln during a severe winter, have been destroyed. The discovery of a dead body in such a situation, would commonly suffice to demonstrate the real cause of death; but a practitioner ought not to be the less prepared to show that there existed no other apparent cause of death about the person. It is obvious that an individual might be murdered and his body placed subsequently near the kiln by a murderer, in order to avert suspicion. If there be no external marks of violence, the stomach should be carefully examined for poison; in the absence of all external and internal lesions, medical evidence will avail but little; for a person might be criminally suffocated, and his body, if found under the circumstances above stated, would present

An accident is related by Foderé to have occurred at Marseilles in 1806, where seven persons of a family were destroyed in consequence of their having slept on the ground-floor of a house, in the court-yard of which a quantity of limestone was being burnt into lime. They had evidently become alarmed, and had attempted to escape; for their bodies were found lying in various positions. The court-yard was enclosed, and the carbonic acid had poured into the apartment through the imperfectly-closed window and door. In November, 1838, a man died three days after having been exposed to the vapours of a lime-kiln. (G. H. Rep. April, 1839.)

The vapour of a brick-kiln is equally deleterious, the principal agent being carbonic acid, although ammonia and muriatic acid are also evolved. In September, 1842, two boys were found dead on a brick-kiln near London, whither they had gone for the purpose of roasting potatoes. Although the cause of death in the two cases was clearly suffocation, in one instance the body was extremely livid, while in the other there was no lividity whatever.

CONFINED AIR.—An animal confined within a certain quantity of air, which it is compelled to respire, will soon fall into a state of lifelessness. A human being in the same way may be suffocated, if confined in a close apartment where the air is not subject to change or renewal, and this effect is hastened when a number of persons are crowded together in a small space. The change which air, thus contaminated by respiration, undergoes, may be very simply stated. The quantity of nitrogen in a hundred parts will remain nearly the same, the quantity of oxygen will probably vary from eight to twelve per cent., while the remainder will be made up chiefly of carbonic acid. Such air will also have a high temperature if many persons are crowded together, and will be saturated with aqueous vapour containing animal matter poured out by the pulmonary and cútaneous exhalants. From this statement, it is evident that air which has been contaminated by continued respiration, will operate fatally on the human system, partly in consequence of its being deficient in oxygen, and partly from the deleterious effects of the carbonic acid contained in it. The proportion in which carbonic acid exists in respired air must be subject to great variation: according to the experiments of Allen and Pepys, it never exceeds ten per cent. by volume of the mixture, how frequently soever it may have been received into and expelled from the lungs. Dalton found that the air in crowded rooms contained about one per cent. of carbonic acid, the atmospheric proportion being therefore increased tenfold. It is certain that insensibility and death would ensue in a human adult, before the whole of the oxygen of the confined air had disappeared; but the opportunity can rarely present itself of analysing such a contaminated mixture, and hence it is impossible to specify the exact proportion in which carbonic acid would exist when the confined air had proved fatal to persons who had respired it.

CHEMICAL ANALYSIS.—Sometimes a medical jurist may be required to state, for the purposes of justice, the nature of the gaseous mixture in which a person may have died. He will have but little difficulty in determining whether carbonic acid is the deleterious agent in such a mixture. When it exists in a confined atmosphere, its presence may be identified, if previously collected in a proper vessel, by the following characters. 1. It extinguishes a taper if the proportion be above twelve or fifteen per cent., and from the extreme density of the gas, the smoke of the extinguished taper may be commonly seen to float on its surface. 2. Lime-water, or a solution of subacetate of lead, is instantly precipitated white when poured into a jar of the gas, and the precipitates thus formed, may be collected by filtration, and proved to possess the well-known properties of carbonate of lime or lead. Air containing only one per cent. of carbonic acid scarcely affects lime-water. 3. When a solution of chloride of lime, coloured by litmus, is added, the blue colour on agitating the liquid in the gas, is discharged. This clearly distinguishes carbonic acid from nitrogen.

The proportion in which carbonic acid exists in a mixture, may be determined by introducing into a given quantity in a graduated tube over mercury, a strong solution of caustic potash. Absorption will take place after a certain time, and the degree of absorption will indicate the proportion of carbonic acid present. When this destructive agent exists in a confined spot, as in a well or cellar, it may be generally got rid of by placing within the stratum a pan containing the hydrate of lime, loosely mixed into a paste with water, or by exciting combustion at the mouth of the pit. Lives are often successively lost on these occasions, one individual descending after another, in the foolish expectation of at least being able to attach a rope to the body of his companion. The moment that the mouth falls within the level of the stratum, all power is lost and the person commonly sinks lifeless.

The gas may be collected by lowering a bottle filled with fine sand by means of a string attached to the neck, guiding the bottle by another string attached to its base. When the bottle is within the stratum it should be turned with its mouth downwards, then rapidly raised with its mouth upwards, by pulling the string attached to the neck.

In concluding this account of carbonic acid, there is one other circumstance which deserves to claim our attention. It is a matter of very popular belief, and, in fact, it is generally asserted by writers on asphyxia, that the burning of a candle in a suspected mixture of carbonic acid and air, is a satisfactory proof that it may be respired with safety. Recent observations have, however, tended to show that this fact is not to be relied on as an indication of security. A case is related by Dr. Christison, where a servant, on entering a cellar in which grape juice was fermenting, was suddenly seized with giddiness. She dropped her candle on the floor, but had time to leave the cellar and shut the door behind her, when she fell down senseless. Those who went to her assistance found, on opening the door, that the candle was still burning. Another case is referred to, where in an attempt at suicide, on entering the apartment, the person was discovered to be in a state of deep coma, while the pan of charcoal was still burning, and in an instance just now reported the same fact was observed. In order to ascertain how far reliance was to be placed upon this popular sign of the salubrity of the air, the following experiments were made:—

1. Twenty-two cubic inches of carbonic acid were mixed with one hundred and ninety-eight cubic inches of air. The mixture was allowed to stand four days, in a mean temperature, and was occasionally agitated in order to promote the equable diffusion of the gas. On introducing a lighted taper or candle into this mixture, it continued to burn without any perceptible diminution in the brilliancy of its flame. 2. Twenty cubic inches of carbonic acid were mixed with one hundred and forty of air. After allowing the mixture to remain four days, a taper was introduced into the jar, and it burnt with very slight diminution in the intensity of its flame. 3. Twenty c. i. of carbonic acid were mixed with sixty c. i. of air. The taper was introduced into this mixture on the fifth day, and it was found that it continued to burn until it reached the bottom of the jar, which was about fifteen inches in depth. Here the flame was perceptibly less brilliant, and after a few seconds, it became extinguished. In repeating this last experiment several times the flame was, however, immediately extinguished.

These experiments, then, show that a candle will burn in air which is combined with ten, or twelve and a half per cent. of its volume of carbonic acid gas: and, although such mixtures might not prove immediately fatal to man, yet they would soon give rise to giddiness, vertigo, insensibility, and ultimately death, in those who, after having been once immersed in them, did not hasten to quit the spot. In air containing a smaller proportion than this,—five or six per cent. a candle will readily burn, but it is probable that such a mixture could not be long respired without causing fatal symptoms. One point may seem to require explanation, relative to the results of these experiments. The air which is contaminated by frequent respiration, was stated, resting on the observations of Allen and Pepys, never to contain more than ten per cent. by volume of carbonic acid; but it is well known that such air will not support the combustion of a taper, a fact which may seem opposed to the results of the experiments above mentioned In respired air, however, there is a deficiency of oxygen, and a proportional excess of nitrogen. The quantity of oxygen is, therefore, not sufficient to maintain the combustion of the taper, hence it becomes extinguished; but that oxygen is still present may be proved by plunging into the mixture ignited phosphorus, which will burn in air in which a candle is extinguished, and produce the well known pyrophosphoric acid vapours. The asphyxiating atmosphere of a confined apartment, in which charcoal or coal has been burnt, may not contain so much as twelve per cent. of carbonic acid, and yet a candle will be immediately extinguished in it. The explanation above given is also here applicable, for in such an atmosphere there is necessarily a deficiency of oxygen and an excess of nitrogen.

The burning of bodies in gaseous mixtures of this kind appears to depend more on the quantity of oxygen present, than on the proportion of carbonic acid in them; and from the results of experiments, it seems doubtful whether carbonic acid really possesses that strong counteracting influence to the active combustion of bodies which some have represented. In a a mixture of air and carbonic acid, where the latter amounts to fifty per cent., most combustible bodies, if we except phosphorus. are instantly extinguished; but if fifty parts of common oxygen be well mixed with fifty parts of carbonic acid, a candle and other combustibles will burn most brilliantly in such a mixture, so that it would hardly be suspected that any carbonic acid was present. I have even found a candle to burn, although less brilliantly, in a mixture of twenty-five parts of oxygen, and seventy-five parts of carbonic acid. When, however, the oxygen formed only one fifth part, or twenty per cent. of the mixture, the flame of a candle was immediately extinguished. In any of these cases, it cannot be doubted that life would have been speedily destroyed by the respiration of such mixtures, and the facts appear to show that the burning of a candle can be no criterion of safety against the effects of carbonic acid. It is perfectly true that in gaseous mixtures where a candle is extinguished, it would not be safe to venture, but the converse of this proposition is not true; namely, that a mixture in which a candle burns, may be always respired with safety. The last experiment justifies the inference, that carbonic acid has some slight positive effect on the burning of bodies; for it was here in the proportion in which nitrogen exists combined with oxygen in the atmosphere, and yet it is obvious that with respect to combustion it could not be substituted for nitrogen.

Of late years some important medico-legal questions have arisen, relative to the diffusion of this gas in air when produced by combustion. It has been supposed that owing to its great specific gravity, (1·527,) it would collect on the floor of an apartment, would gradually rise upwards and suffocate individuals at different times, according to the level on which they might be placed. Questions on this point have been variously answered, and great difference of opinion has arisen on the subject. Medical witnesses have often lost sight of two important points on which a correct answer to a question of this kind must be based,—1, the law of the diffusion of gases, and 2, the effect of heat in greatly diminishing the specific gravity of a gas naturally heavy.

There is no doubt, that in a narrow or confined vessel, carbonic acid is slow in escaping,—nevertheless it mixes and passes off with the air;—and in the course of an hour or two, in spite of its great specific gravity, none will be contained within the vessel. The well-known Grotta del Cane at Pozzuoli, has been quoted by those who hold that carbonic acid always tends to remain on the lowest level,—but it has been forgotten that in this, and other like cases, carbonic acid is continually issuing from crevices in the soil, to replace that which is lost by diffusion; hence the illustration proves nothing. It may suffice to state, that air and carbonic acid mix readily on contact in all proportions, although they enter into no specific combination; and if we even place a vessel containing hydrogen, a gas much lighter than air, over another containing carbonic acid, after two or three minutes, this body will be found, by appropriate tests, to have mixed with the hydrogen, and the hydrogen to have mixed with the carbonic acid. Thus, then, at common temperatures, carbonic acid has no tendency to remain on the floor or soil, where there is a free access of air or contact with other gases. The effect of combustion is to diminish the specific gravity of the gas, and the carbonic acid therefore ascends with the heated current of air, and diffuses itself in the upper part of an apartment, when there are no means for carrying it off. This is a fact demonstrable by many simple experiments. In burning a quantity of charcoal actively in an open brazier raised above the floor in a large apartment, I found the following to be the mean result of several analyses of the air, collected one foot above the level of the burning fuel, and one foot below the level of the source of combustion, there being no currents to affect the results.

	Above the fuel.	Below the fuel
Carbonic acid·	4·65	4·5
Air	95·35	95·5
	100·	100·

This appears to show that the carbonic acid of combustion has no particular tendency to collect at the lowest level; but that it is really uniformly diffused around, and probably it would be found by careful experiments, that within apartments of small dimensions, – those in which individuals are often accidentally suffocated,—the upper strata of air contain as much or even more carbonic acid than the lower. For this reason, an apartment with a low ceiling is more dangerous under these circumstances, than one which is high-pitched.

In a very large apartment it would of course be improper to test the suffocating properties of the air, by the examination of it at a great distance from the source of combustion; since a person situated near this spot might be destroyed, while one at a distance might escape,—the carbonic acid not having completely diffused itself: or supposing it to have become entirely diffused, the proportion may be so small as to render it harmless. It is well known by the effects of the vapour of a lime-kiln, that one lying at the edge of the kiln may be destroyed, while another at ten yards distance, either on the same level or below it, may entirely escape;—nor would it be possible, in such a case to speculate upon the proportion of carbonic acid which had here destroyed life, except by collecting the air from the spot where the accident occurred, and at or about the time of its occurrence. Another fallacy appears to be, that because a dead body is found recumbent it is inferred that the individual must have lain down and have been destroyed while sleeping. The body of a dead person must always be found thus lying on the floor, unless it be supported; but suffocation may actually have taken place, or at least have commenced, while the person was in the sitting or erect posture.

Admitting that carbonic acid diffuses itself rapidly in a heated current from combustion in a small and closed apartment, it has been supposed that after having become mixed with the air, it would again in great part separate, and fall to the lowest level on cooling by its superior density. In answer to this, it may be said, 1. that there are no facts to support this opinion, while there are many against it; for we do not find that the heaviest and lightest gases, when once really mixed, ever again separate from each other. 2. Practically this explanation amounts to nothing; because before the gas had cooled and reacquired its density,—its asphyxiating properties would probably have had their full effect on all living persons within its reach. Persons are not suffocated by carbonic acid after the fuel is extinguished, and the apartment cooled, but the poisonous action of the gas is commonly manifested, while the fuel is still burning.

The inferences which, it appears to me, we are entitled to draw from the preceding considerations, are 1, that in a small and close apartment individuals are liable to be suffocated at all levels, from the very equal and rapid diffusion of the gases during combustion. 2. That in a large apartment, unless the gas is very rapidly diffused by a draught of air,—the air around the source of combustion may become impregnated with a poisonous proportion, while that at a distance might be still capable of supporting life, because carbonic acid requires time for its perfect and equable diffusion in a very large space.

In an interesting case of alleged murder by carbonic acid, which occurred in Paris a few years since, a question was put to the medical witnesses,—as to the quantity of charcoal required to be burnt in a particular chamber to asphyxiate two adult individuals. (Ann. D'Hyg. 1837, i. 200; also Brit. and For. Med. Rev. xi. 240, and xxiii. 264.) This of course could only be answered approximatively, because in burning charcoal the sole product is not carbonic acid, and the substance itself is by no means pure. Then again much of the carbonic acid formed, may escape in various ways from an imperfectly closed apartment. An attempt was made to infer the quantity of charcoal consumed from the weight of ashes found in the apartment; but no satisfactory answer was given on this point. The prisoner was, however, convicted of murdering his wife by carbonic acid.

CHAPTER LV.

SULPHURETTED HYDROGEN. DRAINS AND SEWERS. COAL-GAS. SMOTHERING.

Sulphuretted hydrogen.—This gas, in a medico-legal point of view, may be considered next in importance to carbonic acid. Individuals are occasionally accidentally killed by it; but the very offensive odour which a small portion of it communicates to a large quantity of air, is sufficient to announce its presence and to prevent any dangerous consequences from taking place. The sulphuretted hydrogen gas, when respired in its pure state, is almost instantaneously mortal. It exerts equally deleterious effects upon all orders of animals, and upon all the textures of the body. It is found to destroy life, even when it is allowed to remain in contact with the skin. Mr. Donovan states that a rabbit, enclosed in a bladder of sulphuretted hydrogen gas, but allowed to breathe freely in the atmosphere, perished in ten minutes. When introduced into the lungs of animals, even in a very diluted state, it has been known to give rise to fatal consequences. Thus, Thénard found that air which contained only one eight hundredth of its volume of this gas, would destroy a dog, and that when the gas existed in the proportion of one two hundred and fiftieth, it sufficed to destroy a horse.

The later researches of M. Parent Duchâtelet would, however, seem to show that the poisonous effects of the gas have been somewhat exaggerated, at least in the application of these results to man. He observed that workmen breathed, with impunity, an atmosphere containing one per cent. of sulphuretted hydrogen, and he himself respired, without serious symptoms ensuing, air which contained three per cent. In most drains and sewers, rats and other vermin are found to live in large numbers; and, according to Gaultier de Claubry, the air in these localities contains from two to eight per cent. (Devergie, ii. 520.) Thus, admitting it to be a poison, even more powerful than carbonic acid, it does not appear to be so energetic as Thénard's experiments would lead us to suppose. An atmosphere containing from six to eight per cent. of the gas, might speedily kill, although nothing certain is known of the proportion required to destroy human life. One fact, however, is worthy of the attention of medical jurists, namely, that the respiration of an atmosphere, only slightly impregnated with the gas, may, if long continued, seriously affect an individual, and even cause death.

M. D'Arcet had to examine a lodging in Paris, in which three young and vigorous men had died successively, in the course of a few years under similar symptoms. The lodging consisted of a bed-room with a chimney, and an ill-ventilated ante-room. The pipe of a privy passed down one angle of the room by the head of the bed, and the wall in this part was infiltrated. At the time of examination there was no perceptible smell in the room, although it was small and low. M. D'Arcet attributed the mortality in the lodging to the slow and long continued action of the emanations from the pipe; and it is highly probable that this was the real cause. (Ann. D'Hyg. Juillet 1836.)

The workmen who were engaged in working at the Thames tunnel, suffered severely during the excavation from the presence of this gas, in the atmosphere in which they were obliged to work. The case was referred to me for examination, by Sir M. I. Brunel, in 1839. The air as well as the water was found to contain sulphuretted hydrogen, which trickled through the roof. It was probably derived from the action of the water on the iron pyrites in the clay. The gas issued in sudden bursts, so as to be at times perceptible by its odour By respiring this atmosphere, the strongest and most robust men, were in the course of a few months reduced to an extreme state of exhaustion, and several died. The symptoms with which they were first affected, were giddiness, sickness and general debility,—they became emaciated and fell into a state of low fever, accompanied by delirium. In one case which I saw the face of the man was pale, the lips of a violet hue, the eyes sunk, with dark areolæ round them, and the whole muscular system flabby and emaciated. Chloride of lime and other remedies were tried for the purification of the air; but the evil did not entirely cease until the tunnel was so far completed that there was a communication from one side to the other, and free ventilation throughout.

SYMPTOMS.—The symptoms produced by sulphuretted hydrogen on the human system, vary according to the degree of concentration in which it is respired. When breathed in a moderately diluted state, the person speedily falls inanimate. The immediate removal to pure air, venesection, and the application of stimulants, and cold affusion, may, however, suffice to restore life. According to the statements made by those who have recovered, this state of inanimation is preceded by a sense of weight in the epigastrium and in the region of the temples, also by giddiness, nausea, sudden weakness and loss of motion and sensation. If the gas in a still less concentrated state, be respired for some time, coma or tetanus with delirium supervenes, preceded by convulsions or pain and weakness over the whole of the body. The skin, in such cases, is commonly cold, the pulse irregular, and the respiration laborious. When the air is but very slightly contaminated by the gas, it may be breathed for a long time without producing any serious symptoms; sometimes there is a feeling of nausea or sickness, accompanied by pain in the head or diffused pains in the abdomen. These symptoms are often observed to affect those who are engaged in chemical manipulations with this gas.

Sulphuretted hydrogen appears to act like a narcotic poison when highly concentrated, but like a narcotico-irritant when much diluted with air. It is absorbed into the blood, to which it gives a brownish black colour, and it is in this state circulated through the body.

POST-MORTEM APPEARANCES.—On examining the bodies of persons who have died from the effects of sulphuretted hydrogen, the following appearances have been observed. The mucous membrane of the nose and fauces, is commonly covered by a brownish viscid mucus. A highly offensive odour exhales from all the cavities and soft parts of the body. These exhalations, if received into the lungs of those engaged in making the inspection, sometimes give rise to very unpleasant symptoms, and even to syncope or asphyxia. The muscles of the body are of a dark colour, and are not susceptible of the galvanic stimulus. The lungs, liver, and the organs generally are distended by black liquid blood. There is also great congestion about the right side of the heart, and the blood is said not to become coagulated after death. The body rapidly undergoes the putrefactive process.

The most common form of accidental poisoning by sulphuretted hydrogen, for it is rare that a case occurs which is not purely accidental, we have occasion to witness in nightmen and others who are engaged in cleaning out drains and sewers, or in the removal of the soil of privies. Such accidents are much more frequent in France than in England, the soil being often allowed to collect in such quantities in Paris and other large cities before any attempt is made to remove it, that it becomes a highly dangerous occupation for the workmen. According to the results of Thénard's observations, there are two species of compound gases or mechanical mixtures of gases, which are commonly met with in the exhalations of privies. The first compound consists of a large proportion of atmospheric air holding diffused through it, in the form of vapour, the hydrosulphuret of ammonia. The hydrosulphuret is contained abundantly in the water of the soil and is constantly rising from it in vapour, and diffusing itself in the surrounding atmosphere. It is this vapour which gives the highly unpleasant odour, and causes an increased secretion of tears in those who unguardedly expose themselves to such exhalations.

The symptoms produced by the respiration of this gaseous mixture, when in a concentrated state, bear a close resemblance to those described as resulting from the action of sulphuretted hydrogen gas. If the person be but slightly affected, he will probably complain of nausea and sickness, his skin will be cold, his respiration free but irregular; the pulse is commonly frequent, and the voluntary muscles, especially those of the chest, are affected by spasmodic twitchings. If more seriously affected, he loses all power of sense and motion, the cutaneous surface becomes cold, the lips and face assume a violet hue, the mouth is covered by a sanguineous mucus, the pulse is small, frequent, and irregular: the respiration hurried, laborious, and convulsive; and the limbs and trunk are in a state of general relaxation. If still more severely affected, death may take place immediately; or should the person survive a few hours, in addition to the above symptoms, there will be short but violent spasmodic twitchings of the muscles, sometimes even accompanied by opisthotonos. If the individual be sensible, he will commonly suffer the most severe pain, and the pulse may become so quick and irregular that it cannot be counted. When the symptoms are of such a formidable nature, it is very rare that a recovery takes place. The appearances met with on making a post-mortem examination of the body, are similar to those produced by sulphuretted hydrogen. The inspection should be made with caution, for a too frequent respiration of the poisonous exhalations, may seriously affect the practitioner.

Chemical analysis.—The recognition of these gases is a very simple operation. The odour which they possess is sufficient to determine their presence, even when they are diluted with a large quantity of atmospheric air. The sulphuretted hydrogen gas is at once identified by its action on paper previously dipped in a soluble salt of lead: if present even in very small proportion, the moistened paper speedily acquires a brownish black stain from sulphuret of lead. The sulphuretted hydrogen may be also thus proved to exist in the vapour of hydrosulphuret of ammonia mixed with air; and the presence of ammonia is indicated in the compound by the volatile alkaline reaction on test-paper, also by holding in the vessel containing the vapour recently collected, a rod dipped in strong muriatic acid; the production of dense white fumes announces the formation of the muriate of ammonia. It is a fact which cannot be too universally known, that a candle will readily burn in a mixture of either of these bodies with air, which, if respired, would suffice to destroy life. It is also worthy of remark, that the air of a cess-pool may be often respired with safety until the workmen commence removing the soil, when a large quantity of mephitic vapour may suddenly escape, which will lead to the immediate suffocation of all present. Several persons have been killed by trusting to the burning of a candle, in ignorance of this fact. The best plan for getting rid of the gas is by free exposure of the locality, or by exciting active combustion in it. According to Parent Duchâtelet, men can work in an atmosphere containing from two to three per cent. of sulphuretted hydrogen. The air of one of the principal sewers of Paris gave the following results on analysis in 100 parts: oxygen, 13·79; nitrogen, 81·21; carbonic acid, 2·01; sulphuretted hydrogen, 2·99.

There is another species of deleterious compound present in these exhalations of a very different nature. It is more rarely met with than the preceding, and consists, according to Thénard, in one hundred parts, of ninety-four parts of nitrogen, two of oxygen, and four of carbonic acid gas. Sometimes the carbonic acid gas is combined with ammonia, and then it may be regarded, chiefly, as a mixture of nitrogen holding diffused through it the vapour of carbonate of ammonia, which is sufficient to render it highly irritating to the mucous membrane of the eyes and nose. Its action on the human body when respired, will be readily understood from this statement of its chemical composition. In its operation, it must be regarded as exerting an influence essentially negative; for the small proportion of carbonic acid, or of carbonate of ammonia existing in it, cannot be supposed to give rise to the asphyxia which so rapidly follows its inhalation. The chances of recovery are much greater in persons who become asphyxiated from the inspiration of this compound, than in those who are exposed to the influence of the preceding. Commonly the immediate removal to a pure air is sufficient to bring about a recovery; for the asphyxia is originally induced, owing to there being an insufficient portion of oxygen in the mixture to sustain life. Should death take place, it will be found on a post-mortem inspection, that the internal appearances are the same as those which are met with in the examination of the bodies of the hanged or the drowned.

Chemical analysis.—This compound extinguishes a taper:—the carbonic acid contained in it, may be removed by caustic potash, and then it will be seen that the great bulk of the mixture is formed of nitrogen,—a gas which by its negative properties cannot be easily confounded with any other. In a mixed atmosphere of carbonic acid and sulphuretted hydrogen, the two bodies may be separated by agitating the mixture with a solution of acetate of lead, and treating the precipitate with acetic acid, which dissolves the carbonate, and leaves the sulphuret of lead.

Coal-gas.—Since the introduction of coal-gas for the purposes of illumination, many fatal accidents have occurred from the respiration of air contaminated with it. Coal-gas is a very compound body, acting as a direct poison, and its composition is subject to much variation, according to circumstances. The following are the results of two analyses:

	Mitscherlich.	Tourdes.
Pro-carb. hyd.	56·	22·5
Hydrogen	21·3	31·
Carbonic oxide	11·	21·9
Bicarb. hyd. and pyrelain	7·	6·
Nitrogen	4·7	14·
Carbonic acid	—	4·6
	100·	100·

The difference depends on the heat to which the gas has been submitted. The analysis of M. Tourdes is interesting, because the respiration of this mixture led to the death of five persons. Some consider that carbonic oxide is the poisonous principle; but there is no doubt that the hydrocarbons also have a noxious influence, although the use of the safety-lamp in mines proves that a mixture of protocarburetted hydrogen with air in a small proportion may be respired without producing serious effects.

Symptoms.—The symptoms produced by coal-gas when mixed in large proportion with air, are vertigo, cephalalgia, nausea with vomiting, confusion of intellect with loss of consciousness, general weakness and depression, partial paralysis, convulsions, and the usual phenomena of asphyxia.

Post-mortem appearances.—These will be best understood from the following cases:—

In January, 1841, a family residing at Strasburg, respired for forty hours an atmosphere contaminated with coal-gas which had escaped from a pipe passing near the cellar of the house where they lodged. On the discovery of the accident, four of the family were found dead. The father and mother still breathed, but in spite of treatment, the father died in twenty-four hours; the other recovered. On a post-mortem examination being made of the five bodies, there was a great difference in the appearances; but the principal points observed were congestion of the brain and its membranes—the pia mater gorged with blood,—and the whole surface of the brain intensely red. In three of the cases, there was an effusion of coagulated blood on the dura mater of the spinal canal. The lining membrane of the air-passages was strongly injected; and there was spread over it a layer of thick viscid froth tinged with blood; the substance of the lungs was of a bright red colour, and the blood was coagulated. (M. Tourdes, Ann. D'Hyg. Jan. 1842.)

In two cases, communicated by Mr. Teale to the Guy's Hospital Reports, (No. viii.) there was found congestion of the brain and its membranes, with injection of the lining membrane of the air-passages. In these cases, the blood was remarkably liquid. The circumstances under which the accident occurred were very similar. An old lady and her grand-daughter, who had been annoyed by the escape of gas during the day, retired to bed, and were found dead about twelve hours afterwards.

In the cases above given, the effects produced by coal-gas were owing to its long-continued respiration. The quantity contained in the air of the rooms must have been very small;—in M. Tourdes' case, it was probably not more than 8 or 9 per cent., because a little above this proportion the mixture with air becomes explosive, and there had been no explosion in this case, although in the apartment in which the individuals were found dead, a stove had been for a long time in active combustion, and a candle had been completely burnt out. In Mr. Teale's case, those who entered the house perceived a strong smell of coal-gas; but still the air could be breathed. Coal-gas, therefore, like other aërial poisons, may destroy life if long respired, although so diluted as not to produce any immediate effects in the first instance.

This gas owes its peculiar odour to the vapour of hydrocarbon:—the odour begins to be perceptible when the gas forms the 1000th part:—it is easily perceived when forming the 700th part, but the odour is well marked when it forms the 150th part (Tourdes). In most houses where gas is burnt, the odour is plainly perceived; and it is a serious question, whether health and life may not often be affected by the long-continued respiration of an atmosphere containing but a small proportion. The odour will always convey a sufficient warning against its poisonous effects. It should be known that this gas will penetrate into dwellings in a very insidious manner. In Mr. Teale's cases, the gas-pipe from which the gas had escaped, was situated about ten feet from the wall of the bed-room where the females slept. The gas had permeated through loose earth and rubbish, and entered the apartment through the floor.

It is impossible to determine exactly what proportion of this gas in air will destroy life. An atmosphere containing from seven to twelve per cent. has been found to kill rabbits and dogs in a few minutes,—when the proportion was from one and a half to two per cent. it had little or no effect. With respect to man, it may destroy life if long respired, when forming about nine per cent, i. e. when it is in less than an explosive proportion. (See B. and F. Med. Rev., 29, 253.)

CHEMICAL ANALYSIS.—The circumstances under which the accident occurs will generally suffice to establish the nature of the gas. 1. Coal gas burns with a bright white light, producing carbonic acid and water. A taper should be cautiously applied to a small quantity; since when the gas is mixed with air in the proportion of eleven to fourteen per cent. it is dangerously explosive. For this reason no lighted candle should be taken into an apartment where an accident has occurred, until all the doors and windows have been for some time kept open. The combustion of the gas, or its explosion with air, is a sufficient test of its nature;—the odour and the want of action on a salt of lead will distinguish it from sulphuretted hydrogen.

EXHALATIONS OF THE DEAD.—It may not be inappropriate to make a few remarks in this place, on the supposed danger of the exhalations given off by dead bodies in a state of putrefactive decomposition; although this, it must be confessed, is a subject which more closely appertains to Medical Police. Formerly there existed a groundless fear relative to the examination of a putrefied dead body, and during the last century, on several important occasions, medical witnesses refused to examine the bodies of deceased persons, who were presumed to have been murdered, alleging that it was an occupation which might be attended with serious consequences to themselves. Orfila has collected many accounts of the fatal effects which are recorded to have followed the removal of the dead some time after interment. (Traité des Exhumations, vol. i. p. 2, et seq.) He allows, however, that the details of most of these cases are exaggerated, and attributes the effects which followed to other causes. Indeed the observations of Thouret and Fourcroy prove that these dangers are restricted within a very narrow compass, and that in general with common precautions the dead may be disinterred and transported from one locality to another, without any risk to those engaged in carrying on the exhumations. About the latter part of the last century, from fifteen to twenty thousand bodies, in almost every stage of decomposition, were removed from the Cimetière des Innocens in Paris, and the accidents that occurred during the operations, which lasted ten months, were, comparatively speaking, few. The workmen acknowledged to Fourcroy, that it was only in removing the recently interred corpses and those which were not far advanced in decomposition, that they incurred any danger. In these cases, the abdomen appeared to be much distended with gaseous matter,—if ruptured, the rupture commonly took place about the navel, and there issued a sanious fetid liquid, accompanied by the evolution of a mephitic vapour, probably a mixture of carbonic acid and sulphuretted hydrogen. Those who respired this vapour at the moment of its extrication, fell instantly into a state of asphyxia and died; while they, who were at a distance, and who consequently respired it in a dilute state, were affected with nausea, vertigo, or syncope, lasting for som hours, and followed by weakness and trembling of the limbs. Severa lives have been lost of late years from the crowded state of the burial grounds of London. A deep grave is dug, and this is kept open to b piled with coffins until filled. Persons venturing into these graves ar immediately suffocated. The earth in these localities is strongly im pregnated with poisonous exhalations; and no excavation can be made without its becoming immediately converted into a well of carbonic acid. (See Henke's Zeitschrift, 1840, ii. 446.)

Smothering.—This is only a variety of suffocation, and consists in the mere covering of the mouth and nostrils in any way so as to prevent the free ingress and egress of air. Like drowning, hanging, or strangulation, it produces death by asphyxia. In newly-born infants, it is not an unusual occurrence, sometimes originating in accident and at others in criminal design. A young infant is very speedily destroyed in this way. If the mouth be only lightly covered over with clothing, or slightly compressed, so that respiration is interrupted, as in the act of carrying a child in the arms—this will suffice to cause death, and it is worthy of remark that death often takes place without being preceded by convulsions or other striking symptoms. Smothering is not often resorted to as a means of perpetrating murder, except in infants or in the debilitated and infirm. Certain trials which took place some years since, clearly proved that individuals, in a state of intoxication or infirmity, had been murdered by smothering, for the sake of the money derived from the disposal of the dead bodies! It will be sufficient to mention the trials of Burke and Macdougall in Edinburgh, and of Bishop and Williams in this metropolis, as affording ample evidence of the past existence of this horrible system of secret murder. The victims were commonly destroyed by the murderer resting with his whole weight upon the thorax so as to prevent the motion of the ribs, and at the same time forcibly compressing the mouth and nostrils by his hands, to prevent the ingress of air.

A trial for murder by smothering took place at the Lincoln Lent Assizes, 1843. (The Queen v. Johnson.) The prisoner while committing a burglary tied the arms and legs of the deceased to a bed, so that she could not move, and then closely tucked the clothes over her head. After remaining some hours in this condition, the deceased died. The prisoner was convicted and executed. For an important case, involving the question of death from homicidal smothering or from apoplexy, see the Queen v. Heywood, Lancaster Aut. Ass. 1839.

As an accident, smothering may be conceived to take place when an individual falls in a state of intoxication and debility so that his mouth becomes in any way covered, or the access of air to the external outlets interrupted. On an inspection of the body, the appearances described under the head of asphyxia, will be met with in the organs of circulation and respiration: hence in a suspected case of murder, we must look for the common indications of all the forms of death by asphyxia, and to the circumstances under which the body is found, before we can offer an opinion on the probable cause.

LIGHTNING. COLD. STARVATION.

CHAPTER LVI.

Lightning.—Death by lightning is sufficiently common to require that a medical jurist should be prepared to understand the phenomena which accompany it; but there is a more important reason why he should devote some attention to this subject,—this is, that the appearances left by the electric fluid on the human body, sometimes closely resemble those produced by extreme mechanical violence. Thus a person may be found dead in an open field or on the highway,—his body may present the marks of contusion, laceration or fracture, and to one unacquainted with the fact that such violence occasionally results from the passage of this subtle and invisible agent through the animal system, it might appear that the deceased had been murdered.

The greater number of deaths from this cause take place during the spring and summer. According to the annual report of 1838, there were 24 deaths from lightning registered during that year, occurring in the following seasons:—summer, 11; spring, 10; autumn, 2; winter, 1.

The electric fluid appears to act by producing a violent shock to the brain and nervous system. In a case which did not prove fatal, the patient who was seen soon after the accident, was found labouring under the following symptoms. Insensibility; deep, slow and interrupted respiration; entire relaxation of the muscular system; the pulse soft and slow; the pupils dilated, but sensible to light. (Med. Gaz. xiv., 654.) It will be seen that these are the symptoms of concussion of the brain. The effect of a slight shock is that of producing stunning; and when individuals who have been severely struck recover, they suffer from tinnitus aurium, paralysis, and other symptoms of nervous disorder. Insanity has even been known to follow a stroke of lightning. (Conolly's Report of Hanwell, 1839.) Reaction is best brought about in cases of light shocks by cold affusion, and it may be observed of the effects of lightning generally, that death is either immediate or the individual recovers. A person may, however, linger and die from the effects of severe burns indirectly produced. A case occurred in this city, in July 1838, where death was thus caused indirectly by the effects of electricity. The following is an interesting case of the action of the electric fluid:—

Three persons were at the same time struck by lightning. In one, a healthy man, aged 26, the symptoms were very severe. An hour and a half after the stroke, he lay completely unconscious, as if in a fit of apoplexy;—his pulse was below 60, full and hard, his respiration snoring, his pupils dilated and insensible. There were frequent twitchings of the arms and hands; the thumbs were flexed and immoveable, and the jaws firmly clenched. Severe spasms then came on, so that four men could scarcely hold the patient in his bed; and his body was drawn to the left side. When these had relaxed, he was copiously bled, cold was applied to the head, a blister to the nape of the neck, and mustard poultices to the legs. Stimulating enemata and opium were also administered,—in the course of twenty-four hours consciousness slowly returned, and the man soon completely recovered. The only external injury discoverable was a red streak as broad as a finger, which extended from the left temple over the neck and chest; this disappeared completely in a few days. (B. and F. Med. Rev., Oct. 1842.)

Post-mortem appearances.—Generally speaking, the body, externally, presents marks of contusion and laceration about the spot where the electric current entered or passed out;—sometimes a severe lacerated wound has existed: on other occasions there has been no wound or laceration, but a very extensive ecchymosis, which, according to Mayer, is most commonly found on the skin of the back. I have not met with the account of any case where the appearance of a burn has been produced by the direct action of a stroke of lightning, for in those instances in which the marks of burns have been found upon the body, it appears that ignition of the clothes or articles of furniture, had taken place, to which alone the burning was to be ascribed. The clothes are in almost all cases rent or torn and partially singed, giving rise to a peculiar odour—sometimes even rolled up in shreds and carried to a distance. Metallic substances about the person present traces of fusion, and articles of steel have been observed to acquire magnetic polarity. Actual ignition of the clothes is far from being a usual attendant on the passage of a current of electricity through the human body. Wounds are sometimes met with on the body. These have commonly been lacerated punctures, like a stab produced by a blunt dagger. In the recent case of an individual who was struck but not killed, a deep wound was produced in one thigh, almost laying bare the femoral artery. This individual was struck, as many others have been, while in the act of opening an umbrella during a storm. Fractures of the bones have not been commonly observed; in a case mentioned by Pouillet, the skull was severely fractured, and the bones depressed.

The blood is said not to become coagulated in the bodies of those who have been killed by lightning, while the muscles of such subjects are described as being constantly in a state of perfect relaxation, and never displaying any appearance of cadaverous rigidity. These statements have not been confirmed by observation. Experiments carefully performed, have shown that blood through which electric discharges have been transmitted, will coagulate as quickly as that which has not been electrified; and further, Sir C. Scudamore discovered that, on examining the bodies of animals killed by the discharge of a powerful galvanic battery, the blood in the veins was always in a solid state. There is obviously, therefore, nothing in the action of the electric fluid to retard or prevent the coagulation of the blood. With respect to the alleged absence of cadaverous rigidity, there are many circumstances which may accelerate or retard the accession of this state in the dead muscle,—it may take place and disappear quickly, and the subject may not be seen at that particular time by the medical examiner. Sir B. Brodie has remarked that the body of an animal killed by electricity became, as usual, rigid after death.

Putrefaction is also said to be hastened in these subjects; but putrefaction is modified by many varying circumstances, and death by lightning usually takes place during summer when the process is most readily developed. It does not appear that the process takes place more speedily than in sudden or violent death from any other cause.

Very few reports have been published of the appearances met with in the body, in cases of deathfrom lightning. The body of a person who has died under these circumstances, is seldom examined for a coroner's inquest,—the cause of death being sufficiently obvious without a post-mortem examination.

The following appearances were found in the body of Professor Richman, who was killed at St. Petersburgh in 1753, while engaged in some experiments on atmospheric electricity.

> On the left side of the forehead where the deceased had been struck by the electric current there was a round ecchymosed spot. There were eight other patches of ecchymosis, of variable size, extending from the neck to the hip principally on the left side. Some of these situated on the trunk, resembled the marks produced by gunpowder, when discharged in contact with the skin. The left shoe was torn open at the buckle without being singed or burnt: but the skin around was slightly ecchymosed. Internally a quantity of blood was found extravasated in the trachea, the lungs and the layers of the omentum. The omentum presented the appearance of having been violently contused. (Marbach's Enkyklopädie, Blitz)

Cold.—The protracted exposure of the human body to a very low temperature may become a cause of death, and although in this country cases but rarely occur in which cold alone operates fatally, it is not unusual during a severe winter, to hear of persons being found dead in exposed situations and in a state of misery and destitution. On these occasions, we may reasonably suspect that the want of proper food and nourishment has accelerated death. It is, however, convenient to make a distinction between the effects of cold and of inanition on the system, as the symptoms preceding death and the rapidity with which that event takes place, are very different in the two cases.

Symptoms.—A moderate degree of cold is well known to have an invigorating effect upon the body, but if the cold be severe and the exposure to it long continued, while the calorific function is not maintained by warmth of clothing or exercise, the skin becomes pale and the muscles become gradually stiff and contract with difficulty, especially those of the face and extremities. Sensibility speedily disappears,—a state of torpor ensues, followed by profound sleep from which the person cannot be readily roused: in this state of lethargy, the vital functions gradually cease and the individual finally perishes. Such are the general effects of intense cold on the body.

The effect of cold on the nervous system is seen in the numbness, torpor and somnolency which have been described as consequences of a long exposure to a very low temperature. Giddiness, dimness of sight, tetanus and paralysis, in some cases precede the fatal insensibility which involuntarily steals on the individual. It was observed during the retreat of the French from before Moscow, that those who were affected by cold often reeled about as if in a state of intoxication,—they also complained of vertigo and indistinctness of vision, and sank under a feeling of lassitude into a state of lethargic stupor from which it was found impossible to rouse them. Sometimes the nervous system was at once affected;—tetanic convulsions, followed by rigidity of the whole of the voluntary muscles, seized the individual, and he rapidly fell a victim. Symptoms indicative of a disturbance of the functions of the brain and nervous system, have also been experienced by Arctic travellers during their residence within the Polar circle.

There are certain conditions which may accelerate death from cold. In all cases where there is exhaustion of the nervous system, as in the aged and infirm,—in those who are worn out by disease or fatigue,—or, lastly, in those addicted to the use of intoxicating liquors, the fatal effects of cold are much more rapidly manifested than in others who are healthy and temperate. It has been uniformly remarked that whenever the nervous energy is impaired either by intoxication or exhaustion from fatigue, the subject falls an easy victim to cold. The exposure of persons in a state of intoxication during a severe winter may therefore suffice to destroy life, although the cold might not be so intense as to affect others who were temperate. Casualties of this nature sometimes occur during the winter season in this metropolis; and a knowledge of the influence of intoxication in accelerating death under such circumstances, may occasionally serve to remove any doubt in the mind of a practitioner as to the real cause. Young infants especially when newly born easily perish from the effects of cold.

Cold, when accompanied by rain or sleet, appears to have a more powerfully depressing influence than when the air is dry—probably from the effects of evaporation.

The following case by Dr. Currie, shows the fatal effects of cold winds accompanied by humidity. "Of several individuals who clung to a wreck, two sat on the only part that was not submerged; of the others, all were constantly immersed in the sea, and most of them up to the shoulders. Three only perished, two of whom were generally out of the sea, but frequently overwhelmed by the surge, and at other times exposed to heavy showers of sleet and snow and to a high and piercing wind. Of these two, one died after four hours' exposure,—the second died three hours later, although a strong healthy adult and inured to cold and hardship. The third that perished was a weakly man. The remaining eleven who had been more or less-completely submerged, were taken' from the wreck next day after twenty-three hours' exposure,—and recovered. The person among the whole who seemed to have suffered least was a negro: of the other survivors, several were by no means strong men, and most of them had been inured to the warm climate of Carolina."

POST-MORTEM APPEARANCES.—Opportunities rarely occur of examining bodies, when death results purely from exposure to cold. The surface is commonly pallid and the viscera of the chest and abdomen, as well as the brain, are congested with blood. Dr. Kellie, of Leith, found in two cases which he examined, a redness of the small intestines from turgescence of the capillary vessels, and a great effusion into the ventricles of the brain. A sufficient number of cases have not yet been inspected to enable us to determine how far these two last-mentioned appearances are to be regarded as consequences of death from cold : but all observers have found a general congestion of the vascular system internally. In consequence of the great turgescence uniformly met with in the vessels and sinuses of the brain, some pathologists have regarded death from cold as resulting from an attack of apoplexy; but the symptoms which precede death do not bear out this view. Extravasations of blood have not been met with, and a mere fulness of the cerebral vessels after death, is not in itself sufficient to justify this opinion. It will be observed that on the whole these appearances are remarkably similar to those which are met with in death from severe burns and scalds. (See anté, p. 423.)

Thus then the medical jurist will perceive that to come to a decision whether on the discovery of a dead body, death has taken place from cold or not, is a task of great difficulty. The season of the year,—the place and circumstances under which the deceased is found, —together with the absence of all other possible causes of death, such as from violent injuries or internal disease, form the only basis for a medical opinion. Death from cold is not to be determined except by negative or presumptive evidence, for there is no organic change either externally or internally, sufficiently characteristic of it, to enable us to decide positively on the subject.

The following is a singular medico-legal case involving the question of the fatal effects of cold upon the body.

A man and his wife residing at Lyons, were tried for the murder of their daughter, a girl aged eleven, under the following circumstances. On the 28th December, at a time when there was a severe degree of cold, the female prisoner compelled the deceased to get out of her bed, and place herself in a vessel of ice-cold water. The child cried and endeavoured to escape from the bath ; but she was by violence compelled to remain in the water. The deceased complained of exhaustion and dimness of sight: the prisoner then threw a pail of iced water upon her head, soon after which the child expired. Death was properly ascribed to the effects of this maltreatment, and the parties were convicted. (Ann. D'Hyg. 1831. 207.) This case presents a refinement of cruelty which is rarely met with in the annals of crime. Such a case could only be proved by circumstances : for there would be no post-mortem appearances internally or externally to indicate the mode of death.

We learn by this, that the death of young children may be caused by the external application of very cold liquids coupled with exposure. It would also appear from it, that the brain and nervous system become sympathetically affected through the skin : and not through the introduction of cold air to the lungs. Indeed it is well known that air of a temperature considerably below zero, may be respired without risk, provided the skin be kept warm.

STARVATION.—Death from the mere privation of food is an extremely rare event, although if we were to form an opinion from the verdicts of juries, its occurrence would not appear to be so uncommon in this and other large and populous cities. Such cases, must, however, be received with some distrust, as care is rarely taken to ascertain precisely how far bodily disease may have been concerned in the death of the party. Still it cannot be denied that starvation should be classed among the causes of violent death, being sometimes the result of criminal neglect or inattention in the treatment of children or of infirm and decrepid persons, and thus constituting homicide, or at other times, although very rarely, arising from an obstinate determination to commit suicide in those from whom all other means of self-destruction are cut off.

The SYMPTOMS which attend on protracted abstinence are thus described by Rostan. In the first instance, pain is felt in the epigastrium, which is relieved by pressure. The countenance becomes pale and cadaverous,—the eyes become wild and glistening,—the breath hot,—the mouth dry and parched. A most intolerable thirst supervenes, which, in all cases of attempted suicide by starvation, has formed the most prominent symptom. The body becomes emaciated, the eyes and cheeks sink, and the prominences of the bones are perceptible: the feelings of pain are often so intense as to give rise to fits of delirium. There is the most complete prostration of strength, which renders the individual incapable of the least exertion. After a longer or shorter period, the body exhales a fetid odour, the mucous membrane of the outlets becomes sometimes red and inflamed, and life is commonly terminated by a fit of maniacal delirium or the most horrible convulsions.

The *period* which it requires for an individual to perish from hunger is subject to variation. It will depend materially upon the fact—whether a person has it in his power or not, to take occasionally a portion of liquid to relieve the overpowering thirst which is commonly experienced. The smallest portion of liquid thus taken occasionally, is found to be capable of prolonging life. It is probable that in a healthy subject under perfect abstinence, death would not commonly take place in a shorter period than a week or ten days. This opinion appears to derive support from the results of those cases in which there has been abstinence owing to disease about the organs of deglutition.

POST-MORTEM APPEARANCES.—There are no very satisfactory details of the appearances presented by the bodies of those who have died of inanition: and the cases themselves are too rare to enable us to decide with certainty upon the accuracy of the reports which have hitherto appeared on the subject. The body has been found much emaciated,—the skin dry,—and the stomach and intestines contracted and empty, the mucous membrane sometimes ulcerated: the gall-bladder distended with bile,—the lungs, heart, and great vessels connected with these organs, collapsed and destitute of blood. A good account of the appearances met with in starvation has been published by Dr. Sloan, of Ayr.

A healthy man, aged sixty-five, was by an accident shut up in a coal-mine twenty-three days. For the first ten days he was able to procure and swallow a small quantity of foul water. When found, he could not make the least exertion, nor could he speak above a whisper. Attempts were made to recover him, but he died in three days perfectly exhausted. On inspection, the body was observed to be extremely emaciated,—the intestines were collapsed, the stomach distended with air, and slightly reddened at its cardiac extremity. The liver was small and the gall-bladder distended. The other viscera were in their normal state. (Med. Gaz. xvii. 389.) Mr. Tomkins, of Yeovil, inspected the body of a man who died from starvation, in Feb. 1838. The face was much shrunk and emaciated, the eyes open and presenting a red fiery appearance, as intense as in a case of acute ophthalmia during life. The skin was tough and there was scarcely any cellular membrane to be seen. The tongue, lips, and fauces were dry and rough. A peculiar odour exhaled from the body. The lungs were shrunk and contracted—the pleura slightly inflamed. The stomach and intestines were empty but quite healthy—the gall-bladder was nearly full of bile, and the surrounding parts were much tinged. The urinary bladder was empty and contracted. (Lancet, March 1838.)

These appearances, in order to throw any light upon the cause of death, should be accompanied by an otherwise healthy state of the body: since, as it is well known, they may be produced by many organic diseases, and death may be thus due to disease, and not to privation of food. It is not easy to say whether the emaciation depend on disease or a want of food, unless we are put in possession of the history of the case. On this account it is, that in all charges of homicidal starvation, the defence generally turns upon the co-existence of disease in the body, and the sufficiency of this to account for death. In many of these alleged deaths by starvation, ulceration of the bowels is met with, which some have considered to arise from a want of food. (See the case of the Queen v. Pryke, Chelmsford Summer Ass. 1840.)

Starvation is commonly the result of accident or homicide, but this is a question purely for the decision of a jury,—it cannot be elucidated by medical evidence. The withholding of food from an infant, forms a case of homicide by starvation, on which a medical opinion may be occasionally required. It has been recently held by Mr. Baron Gurney, that the *mother* and not the father is bound to supply sustenance to an infant. The child in this case was aged ten weeks, and the father was charged with wilful murder, on the ground that he had not supplied it with food. The grand jury ignored the bill under the instructions of the judge upon the ground above stated. (The King v. Davey, Exeter Lent Ass. 1835.) But where the husband and wife were charged with the murder of an apprentice to the husband, by using him in a barbarous manner, and the opinion of the medical witness was, that the boy had died from debility occasioned by the want of proper nourishment, it was held that the wife was entitled to be acquitted. as it was the duty of the *husband* and not of the wife to provide sufficient food and nourishment for the apprentice. (The King v. Squire, Starkie, ii. 947.) Starvation is rare as an act of homicide, but it must not be supposed that the law implies by this, the absolute privation of food; for if that which is furnished to a person be insufficient in quantity or of improper quality, and death be a consequence, malice being at the same time proved, then the offender equally subjects himself to a charge of murder. Not many years since, a woman who was accustomed to take parish apprentices, was tried and convicted for the murder of two children, who died in consequence of the bad quality and small quantity of food furnished to them by the prisoner.

RAPE.

CHAPTER LVII.

Rape is defined in law to be the carnal knowledge of a woman by force and against her will. Medical evidence is occasionally required to support an accusation of this kind, but it is seldom more than corroborative, because the facts are in general sufficiently apparent from the statement of the prosecutrix. There is, however, one case in which medical evidence is of some importance, namely, where a false accusation is made. In some instances, as in respect to rape on young children, the charge may be founded on mistake: but in others there is little doubt that it is often wilfully and designedly made for motives, into which it is here unnecessary to inquire. Professor Amos remarked some years since, that for one real rape tried on the circuits, there were on the average twelve pretended cases! In some few instances, these false charges are set aside by medical evidence:—but perhaps in the majority, they are developed by the inconsistencies in the statement of the prosecutrix herself. The duty of a medical witness on these occasions is very simple; and perhaps, this will be best understood by considering the subject under the following heads. It may be observed, that the consent of the female does not excuse or alter the nature of the crime where she is under ten years of age, since consent at this period of life is invalid; and the carnal knowledge of the female is rape in law. Even the solicitation of the child does not excuse it.

Medical evidence in rape may be derived from four sources. 1. Marks of violence about the genitals. 2. Marks of violence on the person of the prosecutrix or prisoner. 3. The presence of certain stains from the spermatic fluid on the clothes of the prosecutrix or prisoner. 4. The existence of gonorrhea or syphilis in one or both. This evidence wlll vary according to the following circumstances.

On young children.—The sexual organs should in these cases present tracesof injury if there has been any resistance whatever on the part of the child; for it is impossible to conceive that any forcible intercourse should have taken place without the production of ecchymosis,—the effusion of blood or the laceration of the pudendum. It has been propounded as a serious question whether a rape can be perpetrated on a child of this age by an adult man; and medical witnesses at trials have been found to adopt diametrically opposite views on the point.

For the legal establishment of the crime, proof of penetration only is demanded, and it would appear from one decision at least, (Rex v. Russen,) that a degree of penetration so slight as not to injure the hymen, would be sufficient to complete the crime. In the case alluded to, the hymen of the child was proved to be entire, and under the direction of the judge, the prisoner was convicted and executed. This trial took place in 1777 ; but since that period, one judge, the present Baron Gurney, has ruled the contrary. He held in one case that there must be a sufficient penetration of the male organ to rupture the hymen, and unless this membrane were found ruptured, the offence would not be complete in law. (Rex v. Gammon, Archbold, Crim. Plea. 406.) According to this decision, the duty of a medical man would simply consist in determining whether the hymen was entire or not. It is, however, hereby left uncertain how those cases would be disposed of, where the hymen has been destroyed by disease, or is congenitally absent. But it is extremely doubtful, whether all of our judges would adopt this view ; they would most probably require a medical opinion, whether there might not be some degree of penetration,—as into the valva, without necessarily rupturing that membrane, and upon this point there appears to me, medically speaking, to be no doubt : also that this penetration might take place without leaving any extensive marks of violence about the pudendum. It must not be assumed by medical witnesses that all these charges of rape on young children are frivolous, and that they impute an impossible crime. Medically speaking, some penetration may take place without a necessary destruction of the hymen; and morally speaking, the crime must be the same, whether this membrane be ruptured or not ; for how is it possible to repress, what society agrees in regarding as a very heinous offence, if medical witnesses are to be allowed to dispute about degrees of penetration for its completion ? It is doubtful whether in any case, there could be a complete introduction of the male organ into the vagina, without laceration and destruction of the soft parts ; but are we to be told upon medical grounds, that no offence analogous to rape can possibly be perpetrated on female infants, unless such marks of physical injury be present ? This is making the proof of the carnal abuse of such children to depend upon mere accident. It is laying down a rule that penetration to the vulva shall not constitute rape, while penetration to the vagina shall be visited by the usual punishment. It is not to be supposed that the law would sanction this view ; for on what pretence could a different punishment be assigned to the two acts. Is the moral injury to the female or to the laws of society, less in the one instance than in the other ?

In a case lately brought before a magistrate, the evidence left no doubt that the crime had been committed on the person of a young girl about ten years old. The surgeon stated that there were considerable marks of violence about the pudendum, but completion (i.e. penetration) was, in his opinion, physically impossible, in a child under ten years of age. Upon this evidence the charge of felony was abandoned.

In the following case, the child was older; but the facts bear immediately upon the question which we are here discussing. It was tried at the Central Crim. Court, March 1843: and the particulars were communicated to the profession by Mr. Adams, of the London Hospital, (See Lancet, March 25, 1843.) A man was charged with a rape upon his own child, aged fourteen. Mr. Adams examined the child about two days after the alleged perpetration of the crime; and he found no injury about the vulva or adjacent parts, and the hymen was unruptured. He gave a positive opinion at the trial, that no rape had been committed. Two other medical witnesses, men of experience and integrity, stated their belief that the crime had been perpetrated. It appears that they had examined the child soon after the alleged offence, and a day or two before Mr. Adams. The prisoner was acquitted of the rape, but found guilty of the assault. The absence of any marks of injury about the vulva, so short a time after the alleged criminal act, and the fact of the hymen being unruptured, in some measure justified the opinion of Mr. Adams, that there was no medical proof of a rape having been commited. At the same time he candidly restricts his opinion, by saying that if by rape we are to understand penetration to the vulva, then was it effected; but there was no evidence to show vaginal penetration:—on the contrary, the unruptured state of the hymen in a forcible intercourse was against this view. The only remark which this case requires, is that the statute law says nothing about the rupture of the hymen as part of the evidence: it merely requires proof of penetration. This may occur and the hymen remain intact. Under these circumstances we shall probably find different judges taking different views of the degree of penetration required; although one cannot perceive that the offence is morally or legally lessened by the fact of the penetration having been so slight as to leave the hymen uninjured.

When, as in the case just related, there are no marks of violence or physical injury about the pudendum of a young child, whether because none originally existed, or they had existed and disappeared by time, a medical witness must leave the proof of rape to others. He can only answer questions of possibility or probability, according to the special facts proved. On the other hand, if marks of mechanical violence are present, they must not always be hastily assumed as furnishing proof of rape; for cases are recorded, where such injuries have been purposely produced on young children, as a foundation for false charges against individuals. The proof or disproof of facts of this kind must rest more upon general than on medical evidence, unless the injuries obviously indicate the use of some weapon or instrument.

It should be remembered that the hymen is not always present in young children:—it may be according to some, congenitally deficient, or, what is more probable, it may have been removed by ulceration or suppurative inflammation of the parts, a disease to which female infants of a strumous habit are very subject. The mere absence of the membrane therefore can afford no proof of the crime, unless we find traces of its having been recently torn by violence.

The existence of a purulent discharge from the vagina has been erroneously adduced as a sign of rape in these young subjects. The parents or other ignorant persons, who examine the child, often look upon this as a positive proof of impure intercourse; and perhaps lay a charge against an innocent person who may have been observed to take particular notice of the child. Some cases are reported, by which it would appear that individuals have thus narrowly escaped conviction for a crime which had really not been perpetrated. If the child be labouring under syphilis or gonorrhea this is positive evidence of impure intercourse either with the ravisher or some other person, but we should be well assured, before giving an opinion, that the discharge is of a gonorrheal, and not simply of a common inflammatory character. The party accused might be at the time free from the disease, or if labouring under it, then we should expect that the discharge suddenly made its appearance in the child with the usual severe symptoms, at a certain interval of time after the presumed intercourse, i. e. about the third, fourth, or fifth day. When these conditions do not exist, it is extremely difficult to form a medical opinion on the subject, since there are no means of distinguishing these sporadic discharges from those which are gonorrheal. Under these circumstances proof must be derived from non-medical sources. With respect to marks of violence on the body of the child, these are seldom met with, because no resistance is commonly made. Bruises or contusions may occasionally be seen on the lower extremities.

Some of the facts connected with rape on young children have just been brought out in the case of the Queen v. Mosely, tried at the Cent. Crim. Court, Sept. 1843. The prosecutrix was a child between twelve and thirteen years of age, and she charged the defendant with having committed a rape upon her, she having made all the resistance in her power. Dr. Merriman stated that he examined the prosecutrix two or three days after the alleged offence was committed; but could not give any decided opinion on the case, although there was every appearance of violence having been used. Another medical witness stated that the prosecutrix had been under his care for the last eight or nine days for disease, (gonorrhea,) with which, in his opinion, she had been infected for a considerable time; and a third proved that the prisoner was not infected with this disease. Dr. Merriman, however, is reported to have said that the prosecutrix was not labouring under the disease when he examined her. It is difficult to explain how this discrepancy on a matter of fact of some importance could have arisen. The jury acquitted the prisoner, probably not trusting to the statement made by the prosecutrix.

On young females after puberty.—When the crime is committed on a female from the age of ten to twelve years, the facts are much the same as those already referred to with respect to children below the age of ten years. There is, however, some difference in the legal complexion of the offence. If carnal intercourse be had with the consent of a female between the ages of ten and twelve years, the offender is guilty of a misdemeanour only. Above the age of twelve years, the consent of the female does away with any imputation of legal offence. Females who have passed this age, are considered to be capable of offering some resistance to the perpetration of the crime; and therefore in a true charge, we should not only expect to find marks of violence about the pudendum, but also injuries of greater or less extent about the body and extremities.

It is likely in these cases, that the hymen would be ruptured, as the intercourse is presumed to be violent ; but there might be some degree of penetration without this being a necessary result. At any rate a young female at this age may sustain all the injury, morally and physically, which the perpetration of the crime can possibly bring down upon her, whatever may have been the degree of penetration ; and for this reason, it is laid down in our law, that the crime consists in the mere proof of penetration. The fact is, however, in general clearly made out by the statement of the female.

With respect to marks of violence on the person, the exact form, position, and extent of these should be noticed ; because a false accusation of rape may be sometimes detected by the violence being in a situation in which it was not probable that the ravisher would have produced it. When bruises are found, the presence or absence of the usual zones of colour may occasionally throw light upon the time at which the alleged assault was committed. (antè, p. 365.)

Unmarried females of the age here supposed, are liable to purulent discharges from the vagina, under which the hymen may be destroyed. At a more advanced age they are frequently subject to leucorrhea. These cases are not likely to be mistaken for gonorrhœa ; as here the female has it in her power to give some account of the circumstances, from which a medical opinion may be easily formed.

On the married.—The remarks already made, apply here with this difference, that where the female has already been in habits of intercourse with the other sex, there is commonly much less injury done to the genital organs. The hymen will, in these cases, be found destroyed and the vulva dilated. Still as the intercourse is presumed to be against the consent of the woman, it is most likely that under proper resistance, some injury will be done to the pudendum, and there will also, most probably, be extensive marks of violence on the body and extremities. Such cases are generally settled without medical evidence from the statement of the female alone, corroborated, as it should be, by circumstances. When a charge of this kind is made by a prostitute, it is very justly received with suspicion, and the case is narrowly scrutinized. Something more than medical evidence would be required to establish a charge of rape under these circumstances. The question turns here, as in all cases of rape upon adult females, on the fact of consent having been previously given or not. This is the point at which the greater number of these cases break down ; and it need hardly be observed, that this question has no relation to the duties of a medical witness :—all that he can do is to establish occasionally, whether or not sexual intercourse has been had with or without some violence. It is obvious, that there may be marks of violence on the person, and yet the conduct of the female may have been such as to imply consent on her part. We must not suppose, as it appears to be commonly done, that medical proof of intercourse is tantamount to proof of rape.

Some medical jurists have argued, that a rape cannot be perpetrated on an adult female of good health and vigour, and they have treated accusations under these circumstances, as false. Whether on any criminal charge, a rape has been committed or not, is of course a question of fact for a jury, and not for a medical witness. The fact of the crime having been actually perpetrated, can alone be determined from the evidence of the prosecutrix and other witnesses. Still a medical man may be able to point out to the court, circumstances which might otherwise escape notice. Setting aside the cases of infants, lunatics, and weak and delicate females, it does not appear probable that intercourse could be accomplished against the consent of a healthy adult female, except under the following conditions :

1. When narcotics or intoxicating liquids have been administered to her, either by the prisoner or through his collusion. 2. When a woman falls into a state of syncope from terror or exhaustion. 3. When several persons are combined against the female, in which case we may expect to find considerable marks of violence about her person. 4. A woman may yield to a ravisher, under threats of death or duress,—in which case her consent does not excuse the crime, but this is rather a legal than a medical question.

It is necessary to observe in relation to the examination of females, that the marks of rape, however strong in the first instance, soon disappear or become obscure, especially in those who have been already habituated to sexual intercourse. After two, three or four days, unless there has been a very unusual degree of violence, no traces of the crime may be found about the genital organs. In unmarried females and in children, where there has been much violence, these marks may persist and be apparent for a week or longer. Supposing at the time of examination, no such marks exist, it may be necessary to consider whether there has been time for them to disappear since the alleged perpetration of the offence ; but it is not in a witness's power to express an affirmative opinion of the commission of the crime ; he must leave this to be proved by the general and circumstantial evidence. Marks of violence on the person can never establish a rape ; they merely indicate, cæteris paribus, that the crime has been attempted.

Of late years, some continental medical jurists have proposed to add to the medical evidence in rape, the examination of spots or stains on the linen of the prosecutrix and prisoner. Thus, it has been recommended to infuse these in water, and examine the liquid with a powerful microscope, in order to observe whether it contain or not the spermatozoa,—long slender eel-like animalcules, which are known to exist in the healthy spermatic secretion. Cases of rape have hitherto been tried, without reference to this species of evidence : nor is it easy to perceive, how this can be necessary to the proof of the crime, when the present law of England demands only proof of penetration and not of emission. Thus, a rape may be legally completed without reference to emission ; and medically speaking, it appears quite possible, that there might be emission without any penetration. Admitting that certain stains of this description are found on the clothes of an accused party, is this to be taken as undeniable proof of the legal completion of rape? It appears to me that it cannot be so taken, and therefore that the affirmative evidence from the microscope, is as liable to lead to error as that which is purely negative. Besides, if such evidence were either required or received, it is impossible to set a limit to the mistakes and fallacies into which a court of law might be led. It could only escape from these by receiving evidence from a practised microscopical observer. Among the reports of numerous trials for rape in our courts, I have never yet met with a single instance in which such evidence was required or would have been of the least utility.

Sometimes the body of a female is found dead, and a medical witness is required to determine whether or not her person has been violated before death. There is here some difficulty, because there may be no statement from the prosecutrix herself. The witness can seldom do more than express a conjectural opinion from the presence of marks of violence on the person and about the genital organs. He must leave the rest to circumstantial evidence.

Capital punishment has been lately abolished in cases of rape. The statute law which refers to this crime is, the 9 Geo. IV. c. xxxi. s. 17, 18. According to the eighteenth section, "Carnal knowledge shall be deemed complete upon proof of penetration only." The words are, perhaps, not sufficiently precise; for by one judge, the law has been thus interpreted—carnal knowledge, i. e., penetration is not complete, unless the hymen be ruptured. This, as it has been suggested, would divide penetration into vulval and vaginal, the former not constituting rape, but a common assault. The policy and justice of admitting a distinction of this kind, either in a moral or legal view, are not apparent; but from a recent decision, it would appear, that such a distinction would not be sanctioned by the majority of our judges.

PREGNANCY. DELIVERY.

CHAPTER LVIII.

Pregnancy.—The subject of pregnancy rarely demands the attention of a medical jurist. There are only two cases in the English law, in which pregnancy requires to be verified, and these so seldom present themselves, that the questions connected with the pregnant state, rather belong to the science, than the practice of medical jurisprudence. For a full account of the signs of pregnancy with the circumstances which occasionally render them obscure, I must refer the reader to the well-known works on Midwifery, of Burns and Denman. These signs are commonly enumerated in the following order: 1. Suppression of the menses. With respect to this sign, it has been a question whether a woman who had never menstruated could conceive and bear a child. Although a rare circumstance, yet cases of this kind have occurred. One will be found reported where a female, aged twenty-five, became pregnant and bore a child; and menstruation was only regularly established afterwards. (See Lancet, Feb. 1842.) Some have contended that the menses are invariably suppressed in pregnancy, but it appears that a discharge, analogous to the menstrual if not identical with it, occasionally manifests itself throughout the whole period of gestation. 2. Prominence of the abdomen. The fallacies attending this sign must be well-known to the practitioner. 3. A change in the breasts, consisting of a fulness acquired by these organs and a darkening and widening of the areolæ. 4. Quickening, which depends on the motions of the child, indicated by syncope, nausea and other symptoms. This may occur from the tenth to the twenty-fifth week; but it most commonly happens between the twelfth and sixteenth week of gestation. 5. Auscultation, whereby the sounds of the fœtal heart may be heard and recognized. 6. There are also certain changes taking place in the cervix uteri, which serve to indicate the pregnant condition.

Pregnancy is sometimes feigned, but it is scarcely necessary to observe, that the imposture may be easily detected by a well-informed practitioner.

One of the cases in the English law, in which pregnancy requires to be verified, is of a civil nature. It is in relation to the Chancery writ "*de ventre inspiciendo.*" A woman may allow that she is pregnant at the time of her husband's death, and the heir-at-law may sue out a writ to require some proof of her alleged pregnancy, as his rights may be materially affected by the result. Until within a recent period, the decision of the question of pregnancy was left to twelve matrons and twelve respectable men, according to the strict terms of the ancient writ; but in one of the most recent cases, it was considered advisable to depart from this absurd custom, and to place the decision in the ands of medical practitioners.

In May 1835, a gentleman named Fox died, leaving a widow, to whom he had not been married more than six weeks. By his will, made some months before his death, he left the great bulk of his property to the use of Ann Bakewell, spinster, for the term of her natural life, so long as she remained sole and unmarried; and after her decease or marriage to one John Marston. Soon after the making of the will, this Ann Bakewell became the wife, and subsequently the widow of Mr. Fox. Notwithstanding that she had married the testator himself, the plaintiff Marston, claimed the property from the widow, on the ground of her having infringed the terms of the will by her marriage. She pleaded pregnancy, and in August 1835, the writ "*de ventre inspiciendo*" was sued out of Chancery by Marston. Some discussion took place in court as to whether the writ should be issued in its original indelicate form or not: i. e., whether the female should undergo examination by the sheriff, assisted by twelve matrons and twelve respectable men! The widow petitioned the court not to issue the writ, and put in an affidavit from her ordinary medical attendant, to the effect that she was pregnant, and too weak to undergo the proposed examination. Ultimately it was decided that two matrons, with a medical man on each side, should visit Mrs. Fox once a fortnight until her delivery. There was no doubt of her pregnancy, and she was delivered at the due time to the great disappointment of the residuary legatee. See Med. Gaz. xvi. 697; xvii. 191. The nature of this judicial examination will be best understood by quoting the terms of the writ addressed to the sheriff. "In propriâ personâ tuâ accedas ad præfatam R. et cam coram præfatis videri et diligenter examinari et tractari facias per ubera et ventrem omnibus modis quibus melius certiorari poteris utrum impregnata sit necne." Register brevium.

There can of course be no difficulty in forming an opinion in such a case, provided the pregnancy be at all advanced. It is, however, not a little singular, that in the present day any attempt should be made to apply the customs of a rude and barbarous age, to the determination of questions of this kind, which belong exclusively to medical science.

The second case in which pregnancy requires to be verified in English law, is in relation to criminal jurisprudence. When a woman is capitally convicted, she may plead pregnancy in bar of execution. The judge will then direct a jury of twelve married women, "*de circumstantibus*," to be empanelled, and sworn to try in the words of the law, "whether the prisoner be with child of a quick child or not." If they find her quick with child, she is respited, otherwise the sentence will take effect. In admitting the humanity of the principle by which a pregnant woman is respited until after delivery, there are two serious objections to the practice of the common law, whereby it is made to fall far short of what, in a civilized country, society has a right to expect from it: these are, 1, that the question of pregnancy is allowed to be determined by a jury of ignorant women accidentally present in court; and 2nd, that the respite is made to depend, not upon proof of pregnancy, but upon the fact of the woman having quickened! This sign of the pregnant state (quickening) has been known to occur so early as the third, and so late as the sixth month; therefore, the execution of females under these circumstances, is a matter of accident, and must depend on the size of the pelvis and certain peculiarities in their constitution! Besides, it is a sign not easily established, except by extorting a confession from the female; and this is the only possible way in which the question could be determined by the jury of matrons. Lastly, it would be difficult to assign any moral or reasonable legal principle, why those pregnant women only who have quickened, should be respited. The bare proof of pregnancy should be of itself sufficient; such is the law of France by Art. xxvii. of the Penal Code. Besides, the means taken by our law to determine the question are bad, and quite unfitted for the present state of society. A jury of matrons thus taken, may be easily deceived with respect to pregnancy; and still more so with respect to the sign of quickening, as it concerns another female. The following case will show that this may happen. (Rex v. Wright, Norwich Lent Assizes, 1832, see Med. Gaz. xii. p. 24, 585.)

The prisoner was found guilty of the murder of her husband by poison. She pleaded pregnancy in bar of execution. The judge empanelled a jury of matrons; and they, after a form of examination had been gone through, brought in a verdict of not quick with child. The woman would have been executed, had not several medical practitioners of Norwich represented to the judge, that the method taken to determine the pregnancy and quickening of the woman, was so unsatisfactory, that no reliance should be placed upon it. The prisoner was then examined by some medical men, and was found to have passed the usual period of quickening! The judge respited the prisoner, and the correctness of the medical opinion was confirmed by the female being delivered within four months afterwards, of a healthy full-grown child. (See Med. Gaz. xii. 22, 585.)

The occurrence of such a case as this, should lead to the total abolishment of the jury of matrons: and it is somewhat satisfactory to perceive by a later instance, that a better system is beginning to prevail. In a case tried in March 1838, a woman was convicted of murder, and pleaded pregnancy. A medical opinion was here required. The pregnancy, if it existed, had so little advanced, that the practitioner was unable to give a satisfactory opinion. The judge respited the prisoner for a month, in order that the witness might have full opportunity to ascertain the fact.

These are, I believe, the only two cases in which pregnancy has any direct relation to medical jurisprudence; and it is remarkable, that with respect to them, the law of England has expressly provided that they should be left to the decision of non-medical persons! I am not aware of any case in law, wherein the fact of pregnancy requires to be verified after the death of a female. The discovery of a fœtus in the uterus, would of course at once solve the question, when the necessity for an examination occurred. If the woman had been pregnant, but the child is no longer found in the womb, then several medico-legal questions may arise in reference to delivery.

DELIVERY.—This subject is of interest to a medical jurist, inasmuch as it is closely related to charges connected with the concealment of birth, abortion and infanticide. For a full account of the signs of delivery, I must refer the reader to works on midwifery; they can here be only briefly noticed in their medico-legal bearings. It will be convenient to consider them as they are found in the living and dead subject.

Delivery in the living.—The signs of delivery are indistinct in proportion to the immaturity of the ovum, and thus when the contents of the uterus are expelled at the second or third month, the fact can rarely be verified by an examination of the female. Abortion at this period, is accompanied only by a loss of blood; but at a later period of gestation, there may be a discharge resembling the lochia, and the os uteri may be found enlarged and softened. If any delay take place in making the examination, no evidence will be derivable from it. Dr. Montgomery met with an instance, in which abortion took place at the close of the second month with considerable hæmorrhage. In twenty-hours, the os and cervix uteri, with the external parts, were almost completely restored to their natural state. (Cyc. Pr. Med. 504.)

The signs of delivery at the full period of gestation, are, 1. The female is weak, the countenance pale, and the eyes surrounded by livid areolæ. The sudden occurrence of this state, from one of previously good health, may create suspicion. 2. The breasts are full, the nipples turgid, and the areolæ around them wide and dark-coloured. 3. The skin of the abdomen is relaxed, thrown into folds, and the cuticle interrupted with light-coloured broken streaks, passing especially from the groins towards the umbilicus. The round form of the semi-contracted uterus may be felt at the lower part of the abdomen on one or the other side. 4. The external parts are swollen, contused or lacerated, with coagula of blood about them: the outlet is dilated; the os uteri open and its margin relaxed. 5. The presence of the lochia. This is at first a discharge of a sero-sanguineous liquid, but which afterwards appears as a brown or green-coloured serum. It commences soon after delivery, and continues from a week to a fortnight, or even longer. This discharge has a very peculiar odour.

These signs of delivery soon disappear, when there is any delay in the examination. In the generality of cases, it is considered to be difficult, if not impossible to say that delivery has certainly taken place, when the examination has not been made until after the lapse of eight or ten days. In some females, these signs become obscure after the fifth or sixth day. The same difficulty exists in attempting to assign the period at which delivery probably took place,—a question sometimes put to a medical witness. He may be able to say whether delivery has or has not recently taken place; but he can rarely state the time except conjecturally. It follows from what has been already said, that when the delivery has taken place at the seventh month or earlier, the signs will be less distinct, and cæteris paribus, will disappear sooner.

A medical jurist may be required to state, whether in a case of infanticide or contested legitimacy, a woman has or has not borne a child at an antecedent period of her life. A question of this kind could only be entertained in relation to delivery at the full period of gestation. The evidence on the point, is rather loose, and is chiefly confined to the presence of shining streaks on the skin of the abdomen,—a brown mark reaching from the umbilicus to the pubes,—and the state of the os uteri, which is said never to close so effectually as in the virgin. In relation to these appearances, it would seem that a woman may be delivered without necessarily having these marks on the skin of the abdomen, and on the other hand, any morbid cause of distension in the cavity might give rise to a similar appearance. With respect to the enlarged state of the os uteri, it must be remembered that this part may become enlarged from disease.

Delivery has been often *feigned* by females, sometimes for the purpose of extorting charity,—for disinheriting parties who have claim to an estate, and at others without any assignable motive. Of course, an imposition of this kind, could not be sustained before a medical practitioner: and detection is rendered easy by the fact, that it is in most cases recent, and not remote delivery which is assumed. The latter would, even if pretended, be generally cleared up by circumstantial evidence. (See case, Med. Gaz. xix. 231.)

Can a female be delivered unconsciously?—When by the signs of delivery and other proofs, it is established that a woman has recently borne a child, she may allege that she was delivered unconsciously. This plea is raised occasionally only in cases of child-murder. There is no doubt that this may occur if the woman be labouring under apoplexy, asphyxia, or syncope;—under the effects of narcotic poisons or intoxicating liquids, but under other circumstances, it can scarcely be admitted as possible. A woman may mistake her condition for calls of nature, and thus be delivered: this is a subject which has been elsewhere considered. (See antè, p. 484.) Dr. Montgomery relates a case where a lady who had borne several children, was unconsciously delivered during sleep:—but it may be doubted whether in the case of a primiparous female, delivery could possibly take place without rousing her from sleep. (For another instance see Brit. and For. Med. Rev. ix. 255.)

Delivery in the dead.—The signs of delivery in the dead body have an immediate relation to the medico-legal questions connected with criminal abortion. Death commonly ensues on these occasions within two or three days after delivery, in which case satisfactory proofs may be generally obtained on inspection;—but if the female have survived three or four weeks, or if, as it commonly happens, the contents of the uterus have been prematurely expelled, then it is not always in our power to give a decided opinion. The contents of the uterus in these cases, are seldom forthcoming.

According to Burns, the following may be taken as the principal appearances, when the body is examined soon after delivery at the full period of gestation. The uterus is like a large flattened pouch from nine to twelve inches long, its mouth being wide open. The cavity contains coagula of blood, or a sanguineous fluid, and its surface is covered with the remains of a decidua. In the part to which the placenta has been attached, the substance of the organ appears exposed, presenting several large semilunar or valvular openings. This portion of the uterus is of a very dark colour. The vessels are extremely large and numerous: the Fallopian tubes, round ligaments and ovaria, are so vascular that they have a purple colour. The spot whence the ovum has escaped, is more vascular than the rest of the ovarian surface.

These appearances will be more or less marked according to the time at which the examination is made. The uterus goes on slowly contracting, and does not become fully contracted, until after about a month. The os uteri never closes so completely as it is found in the virgin state. From this account, it will be perceived that there is as much difficulty in assigning the probable period of delivery in the dead, as in the living subject:—and in determining whether or not a woman has borne a child at an antecedent period. In reference to this last question great importance has been attached to the presence of a *corpus luteum* in the ovary, on the evidence from which a few remarks may be made.

The accounts given by obstetric writers of the characters of these corpora lutea, and the evidence which they are capable of furnishing in legal medicine, are very conflicting. One fact appears to be certain, that morbid productions in the ovary have often been mistaken for them; and that except in the hands of very experienced persons, the means of distinguishing the true from the false corpus luteum are not very clear or satisfactory. Dr. Montgomery states that the ovary presents a protuberance, with a distinct cicatrix on some part whence the ovum has escaped. The protuberant part will be found on section to have an oval form, and to be of a dull yellow colour. It is very vascular, and in texture resembles the section of a kidney. In the centre of this section there will be either a cavity or a radiated white cicatrix, according to the period at which the examination is made. The cavity remains for about three or four months after conception, and is surrounded by a strong white cyst:—as gestation advances, the opposite sides approximate, and a radiated white cicatrix results. The size and vascularity of the corpus luteum are considerably diminished by the time gestation is completed; and in about five or six months afterwards, i. e. fourteen months after its first formation, it disappears altogether from the ovary, so that the corpus luteum of one conception is never to be found with that of another, unless premature expulsion of the contents of the uterus has taken place. (Cyc. Pr. Med., Pregnancy, 496.) The presence of a corpus luteum does not prove that a woman has borne a child. It establishes that conception has taken place: but the embryo may have been converted into a mole or a blighted fœtus.

It was at one time imagined that a corpus luteum might be found in the ovary independently of impregnation; and such is the opinion now entertained by some obstetricians: but it is not improbable that morbid states of the ovary have been mistaken for it. The characters of the false corpus luteum have been thus described. 1. There is no prominence or enlargement of the ovary generally, at the part where it is situated: 2. the external cicatrix is wanting; 3. there are often several in both ovaries; 4. the texture is not glandular, nor can it be injected; 5. when laid open by section, they have neither the central cavity nor the cicatrix which results from its closure. Notwithstanding these characters, the diagnosis is not very easy. For some excellent remarks on the subject with medico-legal cases, and plates, see an Essay by Dr. Paterson, Ed. Med. and Sur. Jour. liii. p. 49. The conclusions to which he comes, are that the false are to be distinguished from true corpora lutea by the following signs. They have in general an irregular form, and want either the central cavity lined with a distinct membrane or the puckered cicatrix. They have no concentric radii and are frequently numerous in both ovaries. The same author relates the following case which shows that the presence or absence of a true corpus luteum may be sometimes important in a case of disputed identity in the dead.

Four medical students were charged with having disinterred the body of a lady, but the body was so disfigured that the deceased could not be identified by her relatives. In one of the ovaries a true corpus luteum was reported to have been found, a discovery which, if true, proved that it could not be the body of that lady, since she was a virgin and advanced in life. On the trial the medical evidence was very conflicting—one half of the witnesses maintained that it was a true corpus luteum which existed in the ovary, while the other half maintained that it was not.

The ovum or embryo.—Hitherto the examination has been confined to the female; but it will now be proper to describe the characters of the ovum or embryo, at the early stages of pregnancy, since when this can be procured, good medical evidence may be derived from an examination of it.

If the ovum be expelled within a month after conception, it is scarcely possible to detect it, owing to its small size, and its being enveloped in coagula of blood. Burns examined three uteri, within the first month, where no expulsion had taken place, but even under these favourable circumstances, he failed in discovering the ovum. At first the ovum contains no visible embryo; but it appears merely to consist of vesicular membranous coverings. According to Burns, when first distinctly seen through its membranes, it is of an oblong form and about a line (the twelfth of an inch) in length. At the sixth week, it is slightly curved, resembling, as it floats, a split pea. In the seventh week it is equal in size to a small bee; and by the end of the second month, it is bent, and as long, as a kidney bean. After this, development goes on rapidly, the features are in part well marked;

and the extremities are gradually formed. At the third month, the fœtus weighs from one to two ounces:—when stretched out, it measures about three inches, and the genital organs, although the sex is not distinguishable, are large in proportion to the rest of the body. The membranes are larger than a goose's egg. At the fourth month the fœtus is from five to six inches long; and weighs from two to three ounces; at the fifth month it measures from six to seven inches, and weighs from five to seven ounces; at the sixth month, its length is from eight to ten inches, and its weight about a pound. For the characters of the child beyond this period, see antè, p. 438.

The great difficulty will consist in determining the nature of the supposed ovum or embryo between the second and third month. In making the examination, it should be placed in water and all coagula gently washed away or removed by some blunt instrument. Alcohol may be used as a substitute for water, after the blood has been removed. If the embryo cannot be found, the decidua and chorion may be recognized:—the former, by its forming the outer investment with its smooth internal and rough external or uterine surface;—the latter by the villous appearance of that portion of it, which would have become the placenta. Between the third and fourth month, the fœtus may be commonly identified without much difficulty.

Moles and hydatids.—The substance expelled from the womb may have been what is termed a mole,—a morbid production of a fleshy or of a bloody structure, appearing like a blighted ovum or placenta. It has been said that a mole is never formed in the virgin uterus; but that its presence always indicates sexual intercourse:—this point, however, is far from settled. The term mole is also attached by some to coagula of blood, polypi or hydatids. In one case reported, a mole and an ovum were expelled together, a fact which shows that they may co-exist. The symptoms accompanying a mole strongly resemble those of pregnancy;—and the appearances produced by its expulsion, are not to be distinguished from those attending the abortion of a fœtus. The only means of diagnosis, would be derived from an examination of the expelled matters.

The signs of pregnancy and delivery may be present in a female; and yet these may be owing to the existence of hydatids in the womb. It was formerly a question, whether conception or previous impregnation was or was not necessary to their formation. Dr. Koch, of Heiligenbeil has reported a case where they were produced independently of sexual intercourse. (Wildberg Jahrb. d. g. S. A. 1. H. 145.) When the mass is expelled, it is found to consist of a group of vesicles or cysts of various sizes:—but sometimes when this disease follows intercourse, the cysts are found mixed up with the remains of a blighted ovum or of a coagulum of blood. Unless the expelled matters be produced, it would be very difficult to say from a post-mortem examination, whether the uterus had contained an embryo or hydatids.

These morbid growths may even be enclosed in an investing membrane similar to the decidua, and there may be the remains of a corpus luteum in the ovary.

Some of the questions which have here been considered were raised on the trial of Mr. Angus, for the murder of Miss Burns, at the Lancaster Assizes, 1808. (See antè, p. 61.)

It was alleged that the deceased was pregnant, and that the prisoner had administered corrosive sublimate to her for the purpose of inducing abortion; and that this had caused her death. A question was raised at the trial, relative to the appearances presented by the uterus as indicative of recent delivery. On examining this organ, it was found to be considerably enlarged, and on its inner surface was a mark, about four inches in diameter, plainly discernible,—to which apparently the placenta had been attached. The os uteri was much dilated. Indeed the appearances were described to be such as might have been expected to be found, two hours after the birth of a full-grown child. The evidence respecting previous pregnancy was conflicting; and the prisoner was acquitted, because the death of the deceased could not be distinctly traced to any criminal act on his part. The ovaries were not examined until after the trial, when what was considered to be a corpus luteum, was found on one of them; and some eminent authorities agreed that it indicated an advanced state of pregnancy. (See Paris and Fonblanque, Med. Jur. ii. 179.) One medical witness appeared for the prisoner: and he contended that the state of the uterus did not justify the medical inference that there had been recent delivery. He assumed that the appearances might have been due to the expulsion of a group of hydatids. On the whole, the medical defence, so to term it, appears to have been more ingenious than sound; and to have rested upon assumptions, which if admitted, would effectually do away with all medical evidence in cases of criminal abortion. The contents of the uterus were not produced, a fact which left the case in mystery.

CHAPTER LIX.

CONCEALMENT OF BIRTH. CRIMINAL ABORTION.

Medical evidence respecting delivery is required in two cases; 1. where the birth of the child is wilfully concealed, and 2, where the contents of the uterus have been prematurely expelled by criminal means.

Concealment of birth.—The concealment of pregnancy is no offence in the English law; but the concealment of delivery, or of the birth of a child, is a misdemeanour by the 9th Geo. IV. c. xxxi. sec. 14.

Be it enacted that if any woman shall be delivered of a child, and shall by secret burying, or otherwise disposing of the dead body of the said child, endeavour to conceal the birth thereof, every such offender shall be guilty of a misdemeanour; and being convicted thereof, shall be liable to be imprisoned with or without hard labour in the common gaol or house of correction for any term not exceeding two years; and it shall not be necessary to prove, whether the child died before, at, or after its birth.

This is the offence of which those females who are charged with infanticide, are most commonly convicted. (See antè, p. 499.) The medical evidence on trials for this offence, is exclusively derived from an examination of the mother; and thus much will depend upon the time at which this is made. With respect to the child, its body need not even be produced provided there be satisfactory evidence of its death.

In the case of the Queen v. Varney, (Oxford Lent Assizes, 1837,) it was proved, that the prisoner had been pregnant and subsequently delivered of a child. Its body had been burnt and only a few remains of the bones of a human fœtus were found in the ashes of a grate. She was convicted of the offence.

According to the statute, the child must be *dead*—the concealment of the birth of a living child not being any offence, unless it should happen to die before its birth was made known. Mr. Chitty says that the child must have advanced to the end of the seventh month; (Med. Jur. 412;) but it is to be presumed that the concealment of the birth of a dead child at the sixth or seventh month would be as much an offence as if it were more advanced. The concealment of a mole or any morbid growth would not probably be considered a contravention of the statute. It will be perceived, that it is not material here, as it is in a case of alleged infanticide, to prove when the child died, whether before, during or after birth; and thus those subtleties and technicalities which have been elsewhere pointed out, (antè, p. 471,) are avoided. In regard to proof of concealment and what constitutes it, these are essentially legal points:—but a medical practitioner may sometimes benefit an accused party, if he can prove that application had been made by her to him, on the subject of her pregnancy and delivery. The law is especially lenient under such circumstances. Questions connected with concealment of birth, do not fall under the jurisdiction of a coroner:—the medical evidence is therefore required by a magistrate. Medical witnesses were, until lately, exposed to much trouble on these occasions, (see Med. Gaz. xix. p. 287,) but the defect has been remedied by a recent statute. (1 Vic. c. xliv.)

SUPPOSITITIOUS CHILDREN.—Another medico-legal case relative to the signs of delivery in a female, and of maturity in a child, occurs where a woman feigns delivery, and represents the child of another person to be her offspring:—or she may substitute another living child for a dead child of which she has been delivered, or for a mole or hydatids which may have passed from her. So again a male may be substituted for a female child, and vice versâ. The practising of a fraud of this nature may seriously affect the rights of inheritance of parties; but it cannot be accomplished without great dexterity, and cunning, or without the co-operation of several accomplices. Frauds of this kind have, in general, been conducted by the aid of a low class of midwives. One instance occurred at Chelsea, in July 1842; where the fraud was brought to light by the death of the supposititious child. The calling in of a professional man, would infallibly lead to discovery, when the question was simply whether delivery had or had not taken place; but when it is alleged that one living child has been substituted for another, the proof of this can no longer depend on medical evidence.

CRIMINAL ABORTION.—By abortion is generally understood in medicine, the expulsion of the contents of the uterus before the sixth month of gestation: if the expulsion take place between the sixth and ninth month, the woman is said to have a premature labour. The law makes no distinction of this kind, but the term abortion is applied to the expulsion of the fœtus at any period of pregnancy. Criminal abortion is rarely attempted before the third month:—these cases perhaps most commonly occur between the fourth and fifth month.

The causes of abortion may be either *natural* or *violent*. The latter only fall under the cognizance of the law:—but a medical witness should be well acquainted with the causes which are called natural, in contradistinction to others which depend on the application of violence. These natural causes are so frequent, that according to Dr. Granville's experience, one in three of all conceptions in the metropolis, terminate in abortion. These causes are commonly ascribable to peculiarities in the female system,—to the presence of uterine diseases, or to some moral shock sustained by the woman during pregnancy. The violent causes of abortion may be of an accidental or criminal nature. In general, the distinction will not be difficult:—the kind of violence and the adequacy of the alleged cause to produce it, will commonly clear up the case.

Criminal causes.—These are either mechanical, or they depend on the use of irritating medicinal substances. They operate with the greater certainty in proportion to the advanced state of the pregnancy. Among the mechanical causes, may be mentioned the violent agitation of the body, as by riding or driving over a rough pavement, in which case no marks of violence would be apparent. Any physical shock, sustained by the body, may operate indirectly on the uterus. Blows or violent pressure on the abdomen are sometimes resorted to; but in these cases, the marks of violence will be perceptible. Instruments have been devised for the purpose of piercing the membranes or destroying the child, and thereby leading to expulsion. Devergie speaks of such instruments being well known in England, and of English midwives deriving a living from the practice of this crime, a statement which it need hardly be said is founded in error. (i. 285.) Although mechanical means are more effectual in inducing abortion, than medicinal substances, yet from the fact of such attempts being made by ignorant persons, the woman generally dies from hysteritis, peritonitis, or other serious after-consequences.

A case was tried in the north of England some years since, in which the evidence showed that the prisoner had attempted to produce abortion in the deceased, by thrusting wooden skewers into the substance of the uterus. Inflammation and gangrene took place and the woman died. The prisoner was convicted and executed for murder.

These mechanical means can seldom be applied to the uterus, without leaving marks of violence on that organ, as well as on the body of the child. If the mother die, a result which generally takes place,—an inspection of the body, will at once settle the point. If the mother survive and the child is expelled, then marks of violence will be found on its body. These marks may not be sufficient to account for death, but that is not here the question. If it can be proved that they have not resulted from accidental causes subsequently to delivery, then their presence will furnish strong corroborative evidence of the actual means by which abortion was attempted. It is said that abortion has been in some instances accomplished by frequent venesection. This effect may follow from the violent shock produced by the loss of a large quantity of blood. An examination of the veins of the arms would show whether any such attempt had been made.

Medicinal substances are perhaps more frequently resorted to for inducing criminal abortion than other means; but they rarely answer the intended purpose, and when this result is obtained, it is generally at the expense of the life of the mother. Mineral poisons have been ignorantly employed for this nefarious object, as arsenic, corrosive sublimate, sulphate of copper and other irritants. Croton oil, gamboge, aloes, elaterium and other drastic purgatives, have also been used for a similar purpose. Purgatives which produce much tenesmus, or powerful emetics or diuretics will readily excite abortion in the advanced stages of pregnancy; but these violent medicines fail in their effect at the earlier stages. The substances just mentioned have an indirect action on the uterus by producing a shock to the general system;—but it is said there is a certain class of bodies called emmenagogues, which have a specific action on the uterus itself. Among these the ergot of rye, or secale cornutum, is particularly mentioned. This substance has been found, in many instances, to bring on violent action of the uterus at an advanced stage of gestation, and when efforts at parturition had already commenced. There is, however, considerable difference of opinion respecting its emmenagogue properties. According to Dr. Lee, it has no effect, at least in the early stages of gestation, although given in very large doses. (Med. Gaz. xxv. 10; see also Ed. Med. Journ. liii. 27.) Dr. Kluge, of Berlin, found that its properties varied according to whether it was gathered before or after harvest;—in the former case, it had an energetic action, while in the latter it was powerless. The properties of the secale are not at all known to the vulgar; and this may account for the fact of our never hearing of cases where it has been criminally administered to pregnant females. Among substances which have acquired popular repute as abortives are savin, rue, iron filings, squills, black hellebore, and cantharides. None of them have any influence on the uterus, except in affecting it indirectly by their irritant action on the system. For an account of the properties of savin, see antè, p. 224. In the coroner's return for 1837-8, there were four cases of the administration of savin and other drugs with the view of procuring abortion. In three of these cases, the mother died undelivered: in the fourth, the child perished. With respect to the signs of abortion in the female, living or dead, see DELIVERY, antè, p. 584.

The English law relative to criminal abortion is laid down in the statute 1 Vict. c. lxxxv. s. 6. By it, capital punishment, which formerly depended on whether the female had quickened or not, is abolished.

> Whosoever with intent to procure the miscarriage of any woman shall unlawfully administer to her, or cause to be taken by her, any poison or other noxious thing, or shall unlawfully use any instrument or other means whatsoever, with the like intent, shall be guilty of felony, and being convicted thereof, shall be liable, at the discretion of the Court, to be transported beyond the seas for the term of his or her natural life, or for any term, not less than fifteen years, or to be imprisoned for any term not exceeding three years.

It is considered doubtful whether, under this statute, a woman could be tried for abortion attempted on herself. The consent or even the solicitation of the female to the perpetration of the crime does not excuse the offender. The crime would never be attempted without the consent of the woman; and, therefore, to admit this as a sufficient defence, would be equal to an entire abrogation of the law.

The means must have been used with the intent to procure the miscarriage of the woman, a point which will be sufficiently established by a plain medical statement of the means employed. Supposing that a drug has been used, the witness will have to state whether it be "a poison or other noxious thing;" for this must be proved, in order that the prisoner should be convicted of the crime. I must refer the reader to what has been said elsewhere (antè, p. 6) in order that he may be able to judge how far the substance administered would fall under the description above given. (See also the case of Haynes, post.) Whether or not the substance would have the effect intended, i. e. of inducing abortion, is perfectly immaterial. Some uncertainty may exist as to the strict meaning of the word noxious:—all will allow that the word implies something injurious to the system; but a difference of opinion may arise among witnesses with respect to its application to the substance under discussion,—as, for example, with respect to rue or savin. A substance must be regarded as injurious to the system or noxious, either according to some specific property which it possesses, or according to the form, quantity, or frequency with which it is administered. Savin and rue are irritant, and become noxious when given in large doses. Aloes and castor oil are innocent substances, when taken in small doses; but they acquire noxious or injurious properties when administered frequently or in large quantity, to a pregnant female. To confine the term noxious, therefore, to what is strictly speaking a poison, would be giving a latitude to attempts at criminal abortion, which would render the law nugatory. It is not required under the circumstances, that any specific injury should have been done to the woman, or that abortion should have followed in order to complete the offence.

In October 1843, a man was tried at the Central Criminal Court, for having caused the death of his wife, (the Queen v. Haynes.) According to the evidence adduced, the prisoner had given to the deceased the night before her death, two ounces of the sulphate of potash dissolved in water, and about a fortnight previously, he had given to her nearly a quarter of a pound of that salt, in two or three doses, with the intention of making her miscarry. The last dose caused great sickness, and she rapidly sank under its effects. On inspection, the stomach was found highly inflamed, and blood was effused on the brain. The woman was not pregnant. The evidence showed that death had been caused by this salt, owing to its having been administered in extremely large quantities. The prisoner was acquitted. There can be no doubt that the sulphate of potash, although innocent in small doses, may have a very serious effect when administered in such large doses as in the present instance. A case has been elsewhere related, where it caused death. (See antè, p. 131.) It appeared that the prisoner and his wife were led to suppose that it possessed abortive properties, which are ascribed to it by popular repute. A portion of the sulphate was examined by Mr. Brande, but was found to be perfectly free from any poisonous ingredient. For an account of the serious effects occasionally produced by this salt, see Med. Gaz. xxxiii. 54.)

It may be proper to offer here a few remarks upon the practice of inducing premature labour, which is adopted by some members of the profession, in cases where there happens to be great deformity of the female pelvis. This practice has been condemned as immoral and illegal, but it is impossible to admit that there can be any immorality in performing an operation to give a chance of saving the life of a woman, when by neglecting to perform it, it is almost certain that both herself and the child will perish. The question respecting its illegality cannot be entertained; for the means are administered or applied with the bonâ fide hope of benefiting the female, and not with any criminal design. It is true, that the law makes no exception in favour of medical men who adopt this practice, nor does it in the statute on wounding make any exceptions in favour of surgical operations; but what is performed without evil intention, would not be held unlawful. The necessity for the practice ought to be apparent;—thus, for instance, it should be shown that delivery was not likely to take place naturally without seriously endangering the life of the woman; it is questionable whether, under any circumstances, it would be justifiable to bring on premature expulsion, merely for the purpose of attempting to save the life of the child, since the operation is necessarily accompanied with risk to the life of the mother. The grounds upon which many eminent authorities have objected to this practice are, 1. That there are few cases wherein parturition, if left to itself, might not take place at the full period; 2. The toleration of the practice might lead to great criminal abuse. 3. It is attended with danger to the mother and child. It is undoubtedly true, that parturition will sometimes take place safely at the full time, even where the deformity of the pelvis is apparently so great, as to lead many accoucheurs to suppose natural delivery to be utterly impossible. Dr. Lilburn has reported the case of a female who laboured under great deformity of the pelvis, but who was twice delivered in safety, and the child survived. (Med. Gaz. xix. 933.) It is, therefore, not improbable that many cases of this kind are prematurely treated, which if left to themselves would do well without interference. Hence a cautious selection should be made; because the operation is necessarily attended with some risk,—it does not ensure safety to the woman and child. All that we can say is, that, according to general professional experience, it places her in a better position, than she would be in, if the case were left to itself. It appears to me that before a practitioner resolves upon performing an operation of this kind, he should hold a consultation with others, and before it is performed, he should feel well assured that delivery cannot take place without greater risk to the life of the mother, than the operation itself would create. These rules may not be acted on in practice; but the non-observance of them is necessarily attended with some responsibility to a practitioner. In the event of the death of the mother or child, he exposes himself to a prosecution for a criminal offence, from the imputation of which, even an acquittal will not always clear him in the eyes of the public. Within the last few years, several practitioners have been tried upon charges of this kind, whether justly or unjustly it is not necessary to consider; but one fact was clear, they neglected to adopt those simple measures of prudence, the observance of which would have been at once an answer to a criminal charge. Because one practitioner may have frequently and successfully induced premature labour without observing these rules, and without any imputation on his character, this cannot shield another who is less fortunate. A charge is only likely to arise where a man has been unfortunate; and the responsibility of one operator cannot be measured by the success of others.

Among other points to which a medical jurist has to direct his attention in charges of criminal abortion, are the following. 1. *Would the law apply to attempts made on females who were not pregnant.* In this case, he would have to verify the fact of pregnancy if disputed. A female may fancy herself pregnant, when she is labouring under ovarian dropsy, or other uterine or abdominal disease. Under this mistaken view, an attempt may be made to procure abortion, and the proof of the corpus delicti will here rest with the medical evidence. It is not a little remarkable, that the pregnancy of the female is not alluded to in the statute:—the words being,—"procure the miscarriage of any woman." These might at first sight appear to include the state of pregnancy; but as we shall presently see, the term "miscarriage" has a much more extensive meaning than this in a popular sense. However, the question in reference to pregnancy has been already settled by our judges:—whatever may have been the intention of the prisoner, or the effects on the female, the crime is not complete, unless she is proved to have been pregnant at the time of the attempt.

A case was tried on the Midland Circuit, July, 1838, where a medical practitioner was charged with this crime. Chief Justice Tindal held that without positive proof of the woman's pregnancy, which was distinctly alleged in the indictment, a conviction could not take place. In this instance, the woman herself denied her pregnancy, and there was no evidence in support of it. The judge directed an acquittal.

On the Spring Circuit of the same year, a man was tried at Lincoln, on a charge of administering a certain noxious drug to a female, with the intent to procure miscarriage. The jury stated their opinion, that the girl was not pregnant when she took the drug. In this case, the prisoner was discharged.

Hence it will be perceived that the proof or disproof of pregnancy, is of material importance in cases of this kind.

2. *Would the law apply if the child were dead in the uterus, or if it were a monster without human shape?*

The symptoms indicative of the death of the child in utero have been elsewhere stated. The death of the child subsequently to the attempted abortion, might perhaps be adduced as corroborative evidence of the crime; but if it were dead at the time of the attempt, it is uncertain whether a conviction would follow. The law is entirely silent on this point; although it cannot be doubted that the expulsion of a dead child would come under the popular signification of a miscarriage; and if the words were strictly interpreted, a prisoner might be convicted whether the child were living or dead, for it has been already said, that it is not necessary that any abortion should have taken place. With respect to monsters, the question actually arose in a case tried at Drôme, in France, in 1841. (Gaz. Méd. Juillet, 1841, also B. and F. Med. Rev. xxiv., 563.)

A girl was accused of procuring abortion. The aborted fœtus, of about the sixth month, was acephalous, and there was no vertebral canal to the spinal column. Other organs were also deficient or imperfectly formed. The medical witnesses declared that it had never breathed, and that its life had ceased with gestation. On the upper part of the body was a wound, which had been produced by a pointed instrument, probably just before it was expelled. This they thought had caused death. The counsel for the prisoner contended that this could not be regarded as a case of criminal abortion, owing to the montrosity of the offspring; and the jury acquitted her. How such a case would be decided in England it is not easy to say.

3. *Would the law apply to cases of extra-uterine pregnancy?*

There can be no doubt that the crime of abortion would apply to cases of this description; because in law it is not required that the fœtus or child should be in any particular situation: hence a person would be equally amenable for the attempt, whether the fœtus were in the uterus, or in the Fallopian tube. The symptoms of extra-uterine pregnancy, especially of the tubal kind, are very similar to those of ordinary pregnancy, so that they are not to be distinguished from them in the early stages.

The use of the word *miscarriage,* in the statute, without any explanation of the meaning assigned to it, will probably create some difficulty on trials for criminal abortion. In a popular sense, (and here a *popular* appears to have been purposely selected in preference to a professional term,) miscarriage signifies the violent expulsion not merely of a child, but of moles, hydatids and other diseased growths, or even of coagula of blood. In these last mentioned cases, the woman is not actually pregnant; although she and the prisoner may imagine that she is. It has been shown by cases already cited, that proof of pregnancy is necessary to the completion of the crime: hence it might be expected, that where the matters expelled show no traces of embryo or fœtus, but on the contrary, are of morbid growth, this would lead to an immediate acquittal, the same as if the woman had never been pregnant. No case of this kind has hitherto occurred; but it has been suggested, that since these morbid growths are indicative of previous intercourse, the prisoner should be found guilty, as much as if the woman had really been pregnant. In answer to this, it may be remarked, that the necessary or constant connexion of these growths with sexual intercourse is an assumption; and admitting that the connexion was proved, it would be like punishing the individual for the intercourse, rather than for the alleged crime of abortion.

It might happen that the attempted abortion was made on a woman whose supposed pregnancy was really due to the presence of a mole or a group of hydatids in the uterus,—the contents of the uterus not having been expelled. If it could be proved, that the symptoms resembling pregnancy were due to a cause of this kind, the charge would probably be dismissed, for the reason that the female was not really pregnant. But how is proof of this kind to be obtained? The diagnosis is extremely difficult. It is probable that without good evidence to the contrary, the law would always presume that the female was really pregnant, and the prisoner would be convicted. Injustice might here be occasionally done: but it is clear, that if the benefit of a medical doubt of this nature were always conceded to the accused party, no conviction could ever take place for criminal abortion, when the contents of the uterus had not been expelled.

BIRTH. INHERITANCE.

CHAPTER LX.

A MEDICAL jurist is sometimes consulted on questions connected with the birth of children.

BIRTH.—The law of England has not defined the meaning of the term birth, in reference to civil jurisprudence; but if we are to be guided by the numerous decisions, which have been made on trials for infanticide, it must be regarded as signifying "the entire delivery of a child, with or without its separation from the body of the mother, (antè, p. 471.) See Chitty Med. Jur. 412. So long as an infant remains in the uterus it is said in law to be "*in ventre sa mere;*" but it is legally supposed to be born for many purposes. (Blackstone's Comm. i., 130.) A child in the womb may have a legacy or an estate made over to it, —it may have a guardian assigned to it, but none of these conditions can take effect unless the child be born alive. So the fœtus may be made an executor; but an infant cannot act as such until it has attained the age of seventeen years!

The most important medico-legal questions connected with this subject are those which arise in contested suits relative to succession or the inheritance of property. A child which is born alive, or has come entirely into the world in a living state, may by the English law inherit and transmit property to its heirs, even although its death has immediately, and perhaps from morbid causes, necessarily followed its birth. Should the child be born dead, whether it died in utero or during the act of birth, it does not acquire any civil rights; for it is not regarded a life in being, unless it manifests signs of life after it is entirely born. Some have considered that partial birth, provided the child be living, should suffice to confer the same rights on the offspring, as the proof of entire birth. The following case has been adduced by Dr. Locock, in support of this view; although the question here was rather in reference to the actual date of birth, than to the acquisition of civil rights therefrom. The principle is, however, the same.

On a Saturday evening, a lady was in labour with her first child. The head and one arm were born two or three minutes before a neighbouring clock struck twelve. There was a cessation of pain for several minutes, during which time the child cried and breathed freely. The rest of the body was not expelled, until full five minutes after the same clock had struck twelve. Was this child born on the Saturday, or on the Sunday? Certainly the birth was not completed until the Sunday:—the child was still partly within the mother,—the circulation was still kept up through the umbilical vessels; "but," continues Dr. Locock, "I gave my opinion, that the child was born on the Saturday. I considered that the child had then commenced an independent existence. The fœtal life had then to all intents and purposes ceased; and respiration—a function incompatible with the condition of a fœtus—had commenced. The umbilical cord will, it is true, go on pulsating for many minutes after an infant has been brought completely into the world crying and kicking, unless it be compressed artificially; and yet no one will say, that the child in such a case is not born until we choose to take the trouble to tie the navel-string. This child would not have been damaged, if it had remained for hours, or even days, with merely its head and arms extended: it could have been fed in this situation." (Med. Gaz. xii. 636.)

However reasonable this view may appear, a medical jurist must shape his evidence according to what the law demands. It has been elsewhere stated (INFANTICIDE, antè, p. 471) that our judges have distinctly laid down the law, that no child can be considered to be born, until the whole of its body has come entirely into the world. This is in relation to criminal jurisprudence, in which case, if in any, the rule should be relaxed; because its relaxation would tend to punish the destruction of living infants partially born. This child could not, therefore, have been born on the Saturday, because the law does not regard partial birth as entire birth; and respiration and birth are not synonymous terms. Supposing this child to have died before its body was entirely extruded, it could not be said even medically, that it was born alive; and certainly it could not be considered, according to the present state of the law, to have acquired the rights of a child born living. The reasonableness of the opinion that partial birth should suffice for all the legal purposes of entire birth, is an entirely distinct question; and one over which a medical witness has no sort of control. Whatever injustice may be done by adhering to this rule in respect to the civil rights of persons, there is no doubt that the evil is of far greater magnitude in relation to criminal jurisprudence; for it would appear from the present state of the criminal law, that partially-born children, although alive and healthy, may be destroyed with impunity.

On the other hand, some difficulty might arise in civil cases, with respect to the bare extrusion of part of the body, sufficing for all the legal purposes of entire birth. It might become a casuistical question, as to how much of the body should be in the world, in order to constitute legal birth; for there is no reason why in a medical view, the extrusion of the head and shoulders, should constitute birth any more than the extrusion of a hand or a foot. If it be said that the act of respiration should be combined with partial extrusion, this would be unjust; because a child is alive,—its heart is evidently pulsating, and its blood circulating as well before the act of respiration as afterwards. Besides it is admitted, that children may be born alive and live for some time without respiring; nor is the want of respiration any objection to these children being considered living in law. A case will be related presently where a child was legally pronounced to have been alive, although it had certainly not respired. If then proof of respiration were not demanded in cases of entire, it could scarcely be required in cases of partial birth. In the event of partial being treated as synonymous with entire birth, there would be no end to litigation; and medical opinions would vary in every case. It is doubtful whether, under such circumstances, the law could be administered with any degree of certainty or impartiality.

Admitting then that a child must be *entirely* born, in order that it should acquire civil rights, it will next be necessary to examine the medical proof required to show that it has been *born alive.* The question here is different to that of live birth in reference to child-murder. We must presume that the practitioner is present at a delivery, in which a child is born in a doubtful state, or where its death speedily follows its birth. The civil rights of the child and its heirs will depend upon the careful observations made by a practitioner, on the circumstances attending the delivery. In some instances, a witness will be required to form an opinion from facts proved by non-professoinal persons.

The visible respiration of a child after its birth, or as it may be manifested by its crying, is an undoubted sign of its having been born alive: but as it has just been stated, a child may acquire its civil rights, although it may be neither seen to breathe nor heard to cry. The pulsation of a child's heart, or even the spasmodic twitching of any of the muscles of the body, is regarded as a satisfactory proof of live birth. The latter sign has been judicially so pronounced,—à fortiori, therefore, the motion of a limb will be considered good evidence in an English court of law, of life after birth. It is to be observed, that the length of time for which these signs of life continue after the child is born, is wholly immaterial:—all that is required to be established is, that they were positively manifested. A child which survives entire birth for a single instant, acquires the same civil rights, as if it had continued to live for a month or longer. These facts will be better understood from the following case of Fish v. Palmer, which was tried in the Court of Exchequer, in the year 1806.

The wife of the plaintiff Fish, who was possessed of property specially settled upon her, died about ten years previously to the trial after having given birth to a child, which was supposed at the time to have been born dead. In consequence of the plaintiff not having had a living child (as it was assumed) by his marriage, the property settled on the wife, was claimed and taken by the defendant Palmer, her heir at law, the husband being obliged to surrender it under these circumstances. From information derived many years subsequently from some women, who were present at the delivery of the wife, the plaintiff was led to think that the child had not been born dead, and that the property had been improperly surrendered. The action was therefore brought to contest the possession, ten years after the death of the wife; and it lay with the plaintiff to prove his allegation—that the child had been born living. Dr. Lyon, the accoucheur, who attended the plaintiff's wife, had died some time before the trial: but it was proved that he had declared the child to have been living an hour before it was born,—that he had directed a warm bath to be prepared, and when the child was born gave it to the nurse to place in the bath. The child neither cried nor moved after its birth, nor did it manifest any sign of active existence: but the two women who placed the child in the bath, swore that, while it was immersed, there appeared twice a twitching and tremulous motion of the lips. They informed the accoucheur of this, and he directed them to blow into its throat; but it did not exhibit any farther evidence of life. The principal question on the trial was:—Whether this tremulous motion of the lips was sufficient evidence of the child having been born alive? The medical witnesses differed. Dr. Babington and Dr. Haighton gave their opinion that had the vital principle been extinct, there could have been no muscular motion in any part of the body:—therefore the child had, in their opinion, been born alive or manifested life after its entire birth. Dr. Denman gave a contrary opinion: he contended that the child had not been born alive, and attempted to draw a distinction between uterine and extra-uterine life. He attributed the motions of the lips after birth, to the remains of uterine life. The jury, however, under the direction of the court, did not adopt this view of the case:—they pronounced the child to have been born living; and by their verdict, the plaintiff recovered the property of which he had been for ten years deprived.

From the result of this case, it would appear that the law does not recognise the distinction attempted to be drawn by Dr. Denman, between what he called uterine and extra-uterine life. A distinction of this kind appears to be purely artificial;—respiration is commonly set down as the mark of extra-uterine life: but a child may breathe and die before it is born, or it may be entirely born and manifest indubitable signs of life without respiring. Respiration therefore is properly regarded by the English law as only *one* sign of life,—the proof of the possession of active and vigorous life is not absolutely required. It cannot be admitted physiologically that any tremulous motion in the muscles, could ever take place spontaneously in a really dead body; and the spasmodic motion of the lips, differs only in degree from the active motion of a leg or an arm. If a certain quantity of life, so to term it, were required to be proved, instead of the bare fact of its presence or absence, the most subtle distinctions would be continually drawn:—thus it might be contended that unless a certain degree of respiration had taken place, it should be assumed contrary to well-known facts, that the child had been born dead. In this respect it appears to me that the law of Scotland must operate unjustly. The law of that country in respect to tenancy, declares that a child cannot be born alive unless it has breathed:—it therefore requires exclusive evidence of respiration. (Ed. Med. and Surg. Jour. xxvi. 369.) It would be as reasonable to demand for exclusive proof of life, the motion of one of the extremities as to insist upon exclusive proof of respiration; for this so varies in degree, that a child may breathe and survive its birth many hours, scarcely receiving any air into its lungs, (antè, p. 456.) Would this be better evidence of live birth, than the distinct motion of a limb? Non-professional persons might be easily deceived as to the fact of respiration in these feeble subjects, and a post-mortem examination would not always remove the doubt:—but no one is likely to be deceived about the motion of an arm or a leg. The power by which a limb is moved is the same as that by which the intercostal muscles are moved in the act of respiration. Those who would thus restrict the proof of life, would do great injustice: for morally speaking, the right of a husband to enjoy for life the property of a wife dying intestate, should not be made to depend upon the accident of a child being born, or of its having survived its birth for a few moments.

On these occasions the mere warmth of the body of a child at its birth would not be evidence of life:—the slightest trace of vital action in its common and true physiological acceptation, would, however, without doubt, be deemed a sufficient proof of the child having been born alive.

Vagitus uterinus.—Let us suppose that the evidence of a child having been born alive, is stated to be that it was heard to cry:—it may be a question for a medical witness in cross-examination, whether this is to be taken as an absolute proof of live birth. The answer must be in the negative, because a child may cry before its body is entirely born:—or it may be what is called *vagitus uterinus,*—a uterine cry after the rupture of the membranes. See antè, INFANTICIDE. As in all cases of this description, there must be eye-witnesses, whether professional or not, the evidence cannot rest solely upon the mere medical possibility of the occurrence of such a cry before birth: and proof will be required of the crying of the child after it was born.

There are two cases in which the determination of the momentary existence of children after birth becomes of importance in a legal point of view. These are in cases involving the questions of Possessio Fratris and Tenancy by the Courtesy.

Possessio Fratris.—In the event of a man twice married dying and leaving a daughter, by each marriage, his estate would be equally shared by the daughters of the two marriages: but if we suppose that there is a son of the second marriage, born in a doubtful state, the legal effect of his momentarily surviving birth, manifested by some slight sign of life, would be to disinherit the daughter of the first marriage entirely, and transfer the whole of the estate to the daughter of the second marriage, she being sister to the male heir, while the daughter of the first marriage is only of half blood. The determination of this point, which does not often occur, must rest essentially upon medical evidence when there is a want of clear proof of life after birth. (See Amos, Med. Gaz. i. 738.)

Tenancy by Courtesy.—This signifies, according to Blackstone, (Com. ii. 426,) a tenant by the courts of England. The nature of this tenancy has been already explained. See the case of Fish v. Palmer, (antè, p. 600.) If a married woman possessed of property specially settled on her, die intestate, it passes from the husband to her heir at law unless there has been a child born living of the marriage, in which case the husband acquires a life-interest in the property. The only defence of this singular custom, is that it is of great antiquity. An attempt was made a few years since to substitute for it the reasonable provision, that the marriage should entitle the husband to a right, which he can now only acquire by the fulfilment of certain accidental conditions. A protracted labour or deformity in the pelvis of his wife, or the necessary performance of craniotomy on a healthy well-formed child, may, under this custom, lead to an aversion of the inheritance.

This tenancy in contested cases, is generally established or disproved by medical evidence: and the following are the conditions which the law requires in order that the right should exist. 1. The child must be born alive. A case has been already related wherein the tremulous motion of a lip was held to be a sufficient proof of live birth. 2. The child must be born while the mother is living. From this it would appear that if a living child were removed from the outlet after the death of the mother, or extracted by the Cæsarean operation from the uterus, the husband could not become entitled to his wife's estate; although the child may survive its removal or extraction. How such a case would be decided in the present day, it is difficult to determine: but one instance is quoted by most medico-legal writers from Lord Coke, where about three centuries since, the case was decided against the husband, in consequence of the child having been removed from the uterus by the Cæsarean section after the death of the wife.

The Cæsarean operation has rarely been performed in England, except when the female was actually dying or dead. But the practice on the continent has been to undertake it while the woman was living, and the result has shown that it may thus be performed successfully both with regard to mother or child. (See Med. Gaz. xix. 829. 878.) For a case in which this operation was successfully performed three times on the same person, see Brit. and For. Med. Rev. July 1836, 270. Important legal consequences may hereafter ensue from the adoption of this practice in England. Thus supposing, in any case, the child were removed alive, while the mother was living, both of them dying shortly afterwards,—Would the husband become a tenant by the courtesy? The law says the child must be *born*: and many lawyers would find good ground for arguing whether extraction by the Cæsarean operation should be regarded as "legal birth." It does not seem to have been contemplated that the operation would ever be undertaken on a living female, and the point is therefore left undetermined.

That a child may be born after the death of the mother, and survive its birth, is proved by the following case.

A woman died during labour. The accoucheur who was summoned found the head of the child presenting, but too high up in the pelvis to allow of the application of the forceps. He immediately introduced his hand into the uterus, and a quarter of an hour after the death of the mother, and twenty hours after the rupture of the membranes, he extracted a male infant in a state of apparent death. The child, which was well-formed, was speedily resuscitated by the application of the ordinary means. (Berlin Medicin. Zeit. July 1836.)

Had this case occurred in England it would probably have been decided according to the old precedent, that the husband could not become a tenant by the courtesy.

3. The child must be born capable of inheriting; therefore if it be a monster, the husband does not acquire the right. There are some other legal conditions which must also be fulfilled, but I have here confined myself to what may become matter for medical evidence. Admitting that there are many legal ways by which the obnoxious parts of this custom may be set aside during the life of the mother, it is hardly just that the knowledge of the necessity for these precautions should be left to be acquired by accident. It would be better to

abolish the custom altogether than to allow the right of the husband to rest upon the execution of deeds, to obviate the injustice which must now necessarily attend its operation. (See the case of Fish v. Palmer, antè, p. 600.)

Date of birth.—Medical evidence has occasionally been demanded in courts of law respecting the actual date of birth of particular parties, in cases where a period of a few days, hours, or even minutes, was required to prove the attainment of a majority,—and therefore legal responsibility for the performance of civil contracts into which the parties had entered, either knowingly or ignorantly when minors. Some such cases have been decided by the evidence of the accoucheur himself, others when the accoucheur was dead by the production of his books; and it is worthy of notice that the strictness and punctuality of some medical practitioners in making written memoranda of the cases attended by them, have in more than one instance led to a satisfactory settlement of such suits, and the avoidance of further litigation.

Plural births.—This has been regarded as a subject appertaining to medical jurisprudence; but I am not aware that there is any case on record, in which the evidence of a medical man was called for respecting it. It is a simple question of primogeniture which has been generally settled by the aid of depositions or declarations of old relations or servants present at the birth. Women may have two, three, four, and five children at a birth. Twins are comparatively frequent, but triplets and quadruplets are very rare. The only circumstance with respect to these plural births which it has been recommended that an accoucheur should attend to, is the order of their occurrence. The first born child, according to the ancient principle of the common law of this country, succeeds to the inheritance. In cases of twin or triplet males, a practitioner would find himself much embarrassed to express an opinion as to which was first born after the lapse of a certain period, unless there were some personal peculiarity or deformity which would at once stamp the identity.

There is one case in which the law has interfered to prevent the inheritance of offspring, and this is in relation to monstrous births.

MONSTERS.—The connexion of teratology with medical jurisprudence, has been most ably investigated by M. Geoffroy St. Hilaire. Although questions connected with these beings do not often occur, yet it is proper that a medical witness should be acquainted with certain facts respecting them. The law of England has given no precise definition of what is intended by a monster. According to Lord Coke, it is a being "which hath not the shape of mankind; such a being cannot be heir to or inherit land, although brought forth within marriage." A mere deformity in any part of the body, such as supernumerary fingers or toes, twisted or deformed limbs will not constitute a monster in law, provided the being still have "human shape." From this it is obvious, that the law must be entirely guided in its decision by the description of the monstrous birth given by a medical witness. It would not rest with him to say, whether the being was or was not a monster—the court would draw its inference from the description given by him.

Various classifications of monsters have been made, but these are of no assistance whatever to a medical jurist, because each case must be judged of by the peculiarities attending it; and his duty will be not to state the class and order of the monster, but simply in what respects it differs from the healthy organised being. In consequence of the want of a sufficient number of precedents on the subject, it is difficult to say what degree of monstrosity would be required in law in order to cut off the civil rights of the being. There are acephalous, dicephalous and disomatous monsters; others, again, like the Siamese twins, united by a mere band of integument. Would an acephalous monster be considered as devoid of human shape? Would a disomatous monster be allowed to inherit as one?—to marry as one?—or how would legal punishment be inflicted in the event of one of the bodies infringing the laws? Such are the singular questions which have been proposed by medical jurists in relation to these beings. There would obviously be ample room for the exercise of much legal ingenuity in respect to these questions. According to St. Hilaire, the rule which has been followed in all countries, respecting these monstrosities, is to consider every monster with two equally developed heads, whether it be disomatous or not, as two beings, and every monster with a single head, under the same circumstances, as a single being. He ascribes the origin of this rule to the performance of the rite of baptism in all christian countries upon each head, where the monster was dicephalous. This view certainly appears rational, when we consider that with two heads there are two moral individualities, while with a single head there is only one will and one moral individuality. But it is doubtful how far this doctrine would be received by jurists and legislators. The question whether in a dicephalo-disomatous monster, the two beings should be bound by the act of one, either in civil or criminal jurisprudence is a matter which, if these monstrosities were more frequent, would give rise to serious difficulties. Such a question is not purely speculative, because it might easily have been raised in respect to the Siamese twins during their stay in this country; and according to St. Hilaire, a case of this kind was actually decided in Paris in the seventeenth century, in relation to a double-headed monster. This author relates that the double monster killed a man by stabbing him with a knife. The being was condemned to death, but was not executed on account of the innocence of one of its component halves! (Ann. d'Hyg. 1837, i. 431.) According to the same authority, compound monstrosity is not transmissible by generation.

Monsters, especially the dicephalous, are either born dead or die very soon after birth, yet within a recent period, two have been known to live, the one Christina Ritta, for nine months,—the other, the Siamese twins, for many years,—the latter may be still living.

Christina Ritta was born in Sardinia, in 1829. The monster was double from the head to the pelvis; the two vertebral columns being distinct as far as the os coccygis. The left bust was christened by the name of Christina, the right by that of Ritta. This monster was brought to Paris, where it died about nine months after its birth. An excellent model of it may be seen in the museum of Guy's Hospital, together with some specimens of the dicephalous and disomatous varieties.

In the further description of it, it may be observed, that below the pelvis, the monster is single. There are two heads resting on two necks; and the union or fusion of the two busts, is effected laterally towards the middle portion of the chest, so that the two corresponding breasts are almost blended. The abdomen, as well as the pelvis, evidently formed by the junction of two primitive pelves, is single. In the chest, there were found two distinct sets of lungs and two hearts; but enclosed in a single pericardium. During life, the pulsations of these organs were so uniform, that there was considered to be only a single heart. There was only one diaphragm, a fact which accounted for the simultaneous death of both bodies; one only having been previously indisposed.

The Siamese twins may be regarded, from the age which they had attained and the probability of their continuing to live, as forming the most remarkable monster in modern times. Many professional men must have had an opportunity of seeing them when exhibited in London in 1831. They had distinct volitions, and would converse at the same time on different subjects; their movements were simultaneous, so as to appear like those of a single being. In short, they could be regarded in no other light than as two distinct beings united by a narrow band. This band of union was, however, so intimate as to render it probable that they had only one peritoneal cavity between them. When either coughed the band swelled up in its whole length. This formed an insurmountable obstacle to their separation. It would, however, have been impossible in relation to criminal and civil jurisprudence to have made both responsible for the acts of one; since they occasionally differed in opinion!

For an account of a case of a monocephalic, disomatous monster, which was born alive, but died soon after birth, see Ed. Med. Jour. lv. 76; and at page 435 of the same volume, is an account of a dicephalous monster, born at Manchester in 1840.

Malpositions, transpositions, or defects of the internal organs of any of the cavities, cannot form monstrous births within the meaning of the English law. The legal question relates only to *external* shape, not to *internal* conformation. It is well known that many internally malformed persons live to a great age; and it is not until after death that malpositions and defects of this kind are discovered. In French jurisprudence, the case appears to be different; if the malposition or defect were such as to be the cause of death soon after birth, the child would be pronounced not "*viable*," and incapable of assuming its civil rights. Some medical jurists have discussed the question of "viability" in new-born children; i. e., their healthy organization with a capacity to continue to live, as if it were part of the jurisprudence of this country; but I am not aware of any facts which bear out this view. The English law does not regard internal monstrosity, and the case of Fish v. Palmer, shows clearly, that the simple question in English jurisprudence is, not whether a child be or be not "*viable*," but whether or not it manifested the least sign of life after it was born. The French law is much more complex, and throws a much greater degree of responsibility on French medical jurists.

LEGITIMACY.

CHAPTER LXI.

GESTATION. PREMATURE BIRTHS. PROTRACTED BIRTHS. PATERNITY.

EVERY child born in lawful matrimony is considered by the English law to be the child of the husband, unless the contrary be made clearly to appear by medical or moral evidence, or by both combined. It is only in reference to medical evidence that the subject of legitimacy can here be considered; but it is extremely rare to find a case of this kind determined by medical evidence alone. There are generally circumstances which show that the child, whose legitimacy is disputed, is the offspring of adultery, while the medical facts may be perfectly reconcilable with the supposition that the claimant is the child of the husband. These cases have been therefore repeatedly decided from moral evidence alone,—the medical evidence respecting the period of gestation or physical capacity in the parties, leaving the matter in doubt. The law which formerly prevailed in this country was to the effect, that if a child were born during marriage,—the husband being within the four seas of the realm, (*quatuor maria,*) and no physical impossibility being proved, the child was legitimate. Access was presumed, unless he could prove that he was "*extra quatuor maria*" for above nine months previously to the birth. (Blackstone, i. 456.) But the present state of the English law on the subject appears to be this. A child born during marriage is deemed illegitimate when by good medical or other evidence it is proved that it was *impossible* for the husband to be the father,—whether from his being under the age of puberty, from his labouring under incapacity from age or natural infirmity,—or from the length of time which may have elapsed since he could have had intercourse, whether from absence or death. With proof of non-access or immorality on the part of the mother, so important on these occasions, a medical witness is not in the least concerned. In some instances, the law assumes without medical evidence that the offspring is illegitimate, as where the husband and wife have been legally divorced "*a vinculo matrimonii.*" When children are born where the divorce is "*a mensâ et thoro,*" they are presumed to be illegitimate until the contrary appear. There is a peculiar difference in relation to legitimacy between the laws of England and Scotland. A child born of parents in Scotland before marriage is rendered legitimate by their subsequent marriage. In England the offspring is illegitimate, whether the parents marry or not after its birth. In the case of Birtwhistle v. Vardell, decided on appeal by the House of Lords in August, 1840, it was held that a child thus legitimated by the law of Scotland, could not be allowed to succeed to his father as heir to real estate in England. The Scotch rule appears more consistentwith natural justice; since, according to the English practice, it is inflicting confiscation on the offspring for a fault in the parents, which they had done all that it was in their power to amend.

These suits are chiefly instituted in respect to the right of succession to property or claims for peerages; and medical evidence is then frequently required to clear up the case. From what has been already said, the English law does not regard the date of conception, which cannot be fixed, but the date of birth, which can be fixed. Medical evidence may relate, 1, to the actual length of the period of gestation:—this may be in a given case so short or so long, as to render it impossible that the husband could be the father. 2. There may be physical incapacity in the husband—he may be too old or too young—or he may labour under some physical defect rendering it impossible that he should be the father. 3. There may be sterility or incapacity in the female, rendering it impossible that the child should be the offspring of a particular woman:—in other words, it may be a supposititious child. (See antè, p. 590.)

Gestation.—The first point to be considered is—what is the natural period of gestation, and whether this is fixed or variable. According to the testimony of the most experienced accoucheurs, the average duration of gestation in the human female, is comprised between the thirty-eighth and fortieth week after conception; but it would appear that the greater number of children are naturally born between the thirty-ninth and fortieth weeks. One cause of this great variation may be, that the common mode of calculation by reference to the suppression of the menstrual discharge, even in a healthy female, must lead to a possible error of two weeks, since there is no sign whereby, in the majority of women, the actual period of conception can be determined. On the other hand, accidental cases have already shown that a great difference exists among females naturally with respect to this period; and it is probable that in no two is it necessarily the same. Thus where there has been only one intercourse, the duration of pregnancy might be easily calculated without reference to any changes in the female constitution: for thereby the date of conception would be accurately fixed. Observations of this kind have shown that females have differed from each other, and that in several instances they have exceeded the period of forty weeks which has been usually set down as the furthest limit of natural gestation. Some have supposed that this difference depended on the male, from analogical observations made on animals, but it more probably depends on differences in the female constitution.

Premature births.—From the preceding remarks we may regard all births before the thirty-eighth week as premature, and all those which occur after the fortieth week as protracted cases; and one great point for a medical witness to determine will be, whether the characters presented by a child, correspond to those which it should present, supposing it to be legitimately born. When the birth is premature, this sort of corroborative evidence may be sometimes obtained; because children born at the fifth or sixth month after marriage cannot, if the offspring of the husband, present the characters of those born at the full period:—supposing that there has been no access between the parties before marriage. It is not so with protracted births; for it is never found that the children are more developed in protracted cases, than they are in those which occur at the full period. For an account of the characters presented by children at different ages, see antè, p. 438, 588. In judging from these marks of development, we must make full allowance for the exceptions to which they are liable. The nearer the supposed premature delivery approaches to the full period of gestation, the more difficult will be the formation of an opinion. Thus it is not always easy to distinguish a child born at the eighth from one born at the ninth month. Burns observes that it is possible for gestation to be completed, and the child perfected to its usual size, a week or two sooner than the end of the ninth month, and other accoucheurs corroborate this view. Thus then a child, born at the eighth month, may be the offspring of the husband:—at the ninth, of an adulterer, but medical facts could not enable a witness to draw any distinction. It is here that moral proofs are necessary; for without these the fact of legitimacy in such a case could not be successfully contested.

The survivorship of a child has been supposed to furnish additional evidence; for it is well known, that under a certain age children are not born living, or if born living they speedily die. Therefore it has been argued, if a child born at the fifth or sixth month after the first cohabitation be born living or survive, this should be taken as a proof of its illegitimacy. The following remarks will, however, show that an argument of this kind may be overstrained.

A medical witness has sometimes been asked—What is the earliest period at which a child can be born to enable it to live and to continue in life after its birth? It is now universally admitted, that children born at the seventh month of gestation are capable of living, although they are more delicate, and in general require greater care and attention to preserve them than children born at the ninth mouth:—the chances are, however, very much against their surviving. It was the opinion of Dr. William Hunter, and it is one in which most obstetric authorities agree, that few children born before the seventh month are capable of arriving at maturity. They may be born alive at any period between the sixth and seventh month, or even in some instances earlier than the sixth: but this is rare, and if born living they commonly die soon after birth. There is one case on record of a child having been born living so early as the fourth month of gestation, (Brit. and For. Med. Rev. ii. 236 :) and another is reported in which a child born at five months and a half, survived its birth between three and four hours. (Med. Gaz. xix. 865.) Capuron mentions an instance where a child was born at the sixth month and a half of pregnancy, and at the time he reported it the child was two years old and enjoyed excellent health. In another instance reported by him, the child was born at the same period, and lived to the age of ten years. (Mèd. Lèg. des Acc. p. 162, 208.) In an instance which fell under my own knowledge, a child was born at the sixth month and a half of gestation, and lived a fortnight. (See another case, Med. Gaz. xxxii. p. 623.) Capuron considers that a child born at the one hundred and eightieth day, or at the sixth month after conception, might be sufficiently mature to live, i. e. that there would be no reason to presume that it was illegitimate, because it survived its premature birth. On the other hand, if born before the sixth month, with sufficient maturity to live, this fact, although by no means a proof, affords a strong presumption of its illegitimacy. Such, I believe, are the principal medical facts connected with the question of premature births ; and the following singular case will serve as an illustration of the difficulties sometimes experienced in forming a medical opinion.

In October, 1835, an investigation ("*fama clamosa*") took place before one of the Presbyteries of Scotland, in reference to certain reports which had been circulated to the prejudice of a minister of the district. It appears that the marriage of this gentleman took place on the 3rd of March, and his lady gave birth to a female child on the 24th of August following ;—i e. one hundred and seventy-four days, or nearly six calendar months after the marriage, and the child continued to live until the 20th of March, 1836. When born it was very weak, and did not weigh more than three pounds. The birth of a living child, together with its survivorship for so long a period, led to the report that there must have been intercourse between the parties previous to the marriage. It was contended that the period was too short for it to have been begotten in wedlock. Dr. Hamilton, of Edinburgh, on being applied to by the Presbytery, said that his own experience was opposed to the probability of a child born at the sixth lunar month surviving ; (the time in this case was six lunar months and six days ;) but he referred to two cases where children born under similar circumstances, had survived their birth for a long period. In one, the lady was delivered within five lunar months (twenty weeks) after the marriage, and Dr. Pitcairn and others gave it as their opinion that it had been begotten within wedlock ; in the other, a woman gave birth to a child nineteen weeks after conception, and it lived a year and a half.

Dr. Thatcher, who examined the child in the case here reported, gave his opinion that it had been begotten on or after the 3rd of March ; and the circumstance of its having been reared in the premature state in which it was born on the 24th of August following, was no objection to this opinion. He considered the complaint made against the minister groundless. The case went through several appeals, and was not finally decided until May, 1839, when the libel was found not proven, and the defendant was absolved from censure. Many medical witnesses in Scotland, and others from France, Italy, and Germany, gave evidence on this occasion—the majority of them being in favour of this having been a legitimate and premature birth. (See Med. Gaz. xvii. 92 ; also Med. Chir. Rev. xxxi. 424.) Although not connected with the medical part of the case, it should be observed that the character of the parties was free from all suspicion,—that no concealment had been practised by them, and that no preparation had been made for the early birth of the child. Although the weight of this child was greater than the average of children born at this early period, yet this is no reason for believing that it was begotten out of wedlock. With respect to its outliving birth, a case has been already mentioned, where a child born at a still earlier period, survived several hours, and others, where children born rather later, lived for two and ten years. It would be in the highest degree unjust to impute illegitimacy to the offspring or a want of chastity to the parents, merely from the fact of a premature child being born living and surviving its birth.

Protracted births.—The question of retarded gestation has given rise to considerable discussion in legal medicine. That gestation may be retarded or protracted beyond the fortieth week, is now scarcely disputed by any obstetric writer of reputation. Some individuals have denied it, because they have not met with such cases in their own experience; but the medico-legal relations of such questions do not depend upon the solitary experience of practitioners. It is only by the accumulation of well-ascertained facts from all authentic sources, that medical knowledge can be made available to the purposes of the law—otherwise by the mere accident of a witness not having met with any exceptional case, a court may be entirely misled in its judgment by trusting to his opinion. It is the more important to attend to this, because most of the cases, involving questions of contested legitimacy or the chastity of individuals, turn upon protracted rather than upon premature delivery.

In the standard works on Midwifery, will be found authentic reports of cases where gestation continued to the forty-first, forty-second, forty-third, and even the forty-fourth week. Dr. Lee recently met with a case in which he had no doubt that the pregnancy lasted two hundred and eighty-seven days:—the labour did not take place until forty-one weeks after the departure of the husband of this lady for the East Indies. (Med. Gaz. xxxi. 917.) Dr. William Hunter met with two instances where gestation was protracted until the forty-second week. Dr. Montgomery met with a case in which delivery did not ensue until between the forty-second and forty-fourth week. (Med. Gaz. xix. 646.) But perhaps the most complete evidence of protracted gestation, as well as the general uncertainty of the duration of that state, is furnished in a table by Dr. Merriman, and is quoted by Dr. Lee. (Med. Gaz. xxxi. 917.) Of one hundred and fourteen pregnancies calculated by him from the last day of menstruation, and in which the children appeared to be mature, the following were the periods:—

In the 37th week	3	In the 41st week	22
38th	13	42nd	15
39th	14	43rd	10
40th	33	44th	4

From these results Dr. Merriman thinks that the greater number of women complete gestation in the fortieth week, and next to that in the forty-first.

The name of Dr. Merriman is a sufficient guarantee for the authenticity of these cases. The longest case which I have found reported is that by Dr. Beck. (Med. Chir. Rev. xxxiv. 556.) It occurred in America in 1840 :—gestation was here protracted to three hundred and thirteen days, or forty-four weeks and five days. It has been supposed that these cases of lengthened gestation were nothing more than instances of protracted parturition : the delivery commencing and continuing over a much longer period than usual. In an instance mentioned by Dr. Jörg, a woman went her full time ; but the parturition lasted a fortnight longer, the symptoms appearing and then disappearing. Admitting that this occasionally happens, still it shows that gestation from a particular pregnancy may be protracted considerably beyond the ordinary period. It is impossible to admit that these cases depend upon some mistake being made in the calculation of the period :—since this calculation was founded on the same principles as those adopted in cases of ordinary pregnancy. Hence, if there were a mistake in the one case, there would be in the other :—if an error in the exception, there would be an error in the rule. Either pregnancy is wrongly calculated at the thirty-eighth and fortieth week, or it is rightly calculated to extend occasionally to the forty-fourth week. But even setting aside the palpable answer to an objection of this nature, some of the cases having been instances of impregnation from one intercourse, it is quite impossible that any such mistake could have arisen respecting them.

In all cases of contested legitimacy, the question respecting the period of gestation, when it arises, is left entirely open by the law. No period has been fixed within which, or beyond which, a child when born in wedlock, should be presumed illegitimate. The decision of a court of law would be founded, quoad the duration of pregnancy, on the opinions of experienced practitioners selected for the occasion, and each case would be decided on its own merits. Precedents can have but little influence on these occasions, because a court may think fit to pronounce illegitimate on non-medical grounds, a child born in the thirty-eighth week of gestation ; while it may decide that another was legitimate that had been born in the forty-third week. By some law-authorities *forty* weeks are set down as the "*ultimum tempus pariendi* :"—but the impression among jurists and physicians in modern times being that the period of human gestation is wholly independent of any legal dictum, it is not the custom of the courts to act upon this as a rule. In two instances children have been pronounced legitimate, which were born, the one in forty-one weeks and three days, and the other in forty-one weeks and four days after the death of the husband. In the following case (Anderton v. Gibbs, 1834) the Vice-Chancellor decided that a child born ten months or about forty-two weeks after intercourse with the husband, was legitimate.

In this case, a verdict had been already returned establishing the legitimacy of the plaintiff; and an attempt was now made to set this aside, among other grounds, upon the plea that the offspring was illegitimate, because it had been born at so long a period after access.

It appeared that the mother of the plaintiff had been living for some time before, and at the period of the birth, in adulterous intercourse; and that about ten months before the birth of this child, she had had a private interview with her husband, when it was assumed that there had been access, but the parties did not meet afterwards. Before the adultery, they had lived together two years without having had issue; and in the present instance the child was born after a period of forty-two weeks, facts which were considered to establish its illegitimacy. The opinions of Sir Charles Clarke and other medical men were adduced at the trial; and these limited the extreme period of gestation to forty weeks; but they at the same time declared that the subject was involved in darkness and uncertainty. The Vice Chancellor considered that the jury at the trial had given a proper verdict by finding for the plaintiff's legitimacy. The jury were not to decide by whom the child had been begotten, but whether it could by any possibility be the child of the husband. With respect to the period of gestation there was no difficulty. Sir Charles Clarke and other authorities confessed that the subject was involved in darkness and mystery; and that the faculty of medicine knew nothing certain about it. There was no positive evidence as to the exact day on which the child was born, nor on which the interview between the husband and wife took place. Therefore this would allow of the period of gestation being reduced to about forty-two weeks or less. The legitimacy of the plaintiff was in his opinion legally established.

From this case it will be seen that a child may be affiliated on the husband, although the wife may be at the same time living in adulterous intercourse with another person.

One of the most interesting cases in relation to this subject was the Gardner Peerage case, which came before the House of Lords in 1825; and a full account of which has been published by Dr. Lyall. (Med. Ev. in Gardner Peerage case, 1827.)

Alan Legge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the parliament roll. The peerage was, however, claimed by another person, Henry Fenton Jadis, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate; and in order to establish this point, the evidence adduced was partly medical and partly moral.

Lady Gardner, the mother of the alleged illegitimate child, parted from her husband, on board of his ship, on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child, whose legitimacy was disputed, was born on the 8th of December of that year. Therefore the plain medical question was, whether a child born forty-four weeks and four days after intercourse, (from January to December,) or twenty-one weeks and three days, (from July to December,) could be considered to be the child of Lord Gardner. If this were answered in the affirmative, then it followed that this must have been a very premature or a very protracted birth. There was no pretence that this was a premature case, the child having been mature when born. The question then was reduced to this—Was this alleged protracted gestation consistent with medical experience? Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion, that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child. On the moral side of the question, it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jadis, and on this ground Lord Gardner obtained a divorce from her after his return. He subsequently married a second wife, by whom he had the claimant, Alan Legge Gardner. It was contended that the other claimant was really the son of Lady Gardner by

Mr. Jadis. The decision of the House was, that this claimant was illegitimate; and that the title should descend to the son of the second Lady Gardner.

This decision appears to have been chiefly based on moral circumstances; for had not the first Lady Gardner been living in open adulterous intercourse at the time of her husband's departure, it is highly probable, from the medical evidence bearing that way, that the legitimacy of the child would have been allowed. Again, supposing that the child had been born two or three weeks earlier, the question would have resolved itself into this—who had begotten the child?—the husband or the adulterer. This could not have been decided, and then, probably, as in the more recent case of Anderton v. Gibbs, (antè, p. 613,) the course of law would have pronounced the husband to have been the father. The House then must have considered, that the medical opinions, without cases to support them, could not be safely received. It is obvious that the possibility of gestation being protracted, must stop somewhere; and the court probably, thought that they had here reached that point. Morally speaking, the decision could not be impugned; but medically speaking, it was incorrect; inasmuch as a court of law never pretends to settle who begat a child, where the pregnancy might by any possibility be ascribed to the husband or an adulterer. The House of Lords, however, here decided that the adulterer begat the child; and by implication their decision involved this medical point,—that it is quite *impossible* the husband can be the father of a child born forty-four weeks and four days after access. A reference to Dr. Merriman's table, (antè, p. 611,) will show that this is a dangerous decision; for in four cases, this gentleman has known pregnancy to extend to the forty-fourth week, which would nearly cover the time here in dispute. But Dr. Beck, a physician of competent authority, has met with a case in which gestation was actually protracted to forty-four weeks and five days; i. e., one day longer than the period in the Gardner case, (antè, p. 612.) Supposing this case to be reheard, and the evidence of Dr. Beck called for, could the House vindicate its former decision? It would be found that they had pronounced to be impossible what had actually come to pass; and either the decision would be the other way, or it would be contrary to that general rule of law, upon which so many decisions have been framed, that even although the wife may be living in adultery, the husband shall be presumed to be the father of her children, unless there is a proof of non-access—or absolute impossibility from the duration of the pregnancy. It is satisfactory to the majority of those who gave evidence in the Gardner case, to know that the conclusion to which they had come respecting the possibility of gestation being protracted to forty-four weeks and upwards, has been since confirmed by the occurrence of a well-marked case. The decision of the House of Lords, admitting that it was consistent with justice in this instance, can, it appears to me, only be defended on the principle, that when a married woman has had intercourse about the same period with her husband and an adulterer, her offspring should be bastardized on the mere proof of her adultery. Would courts of law always act on this principle?

The following case (Luscombe v. Prettyjohn, Exeter Summer Ass. 1840) will show how unsettled legal opinions are upon these points; and that disputed questions of gestation are sometimes decided without medical evidence; although there are few instances in which it is more urgently required.

An action was brought against the defendant, by a farmer, to recover compensation for the loss of his daughter's services. It was alleged that the defendant had seduced her, and that she was delivered of a child of which he was the father. He denied that the child was his, among other reasons, on the ground that it was born two hundred and ninety-nine days, or forty-two weeks and five days after intercourse. No medical evidence was called to show that gestation might be thus far protracted; but the judge in summing up, made the following observations: "Upon the evidence it was almost impossible that he (the defendant) was the father." "Supposing that she (the woman) were right, that would place the birth at nine calendar months three weeks and five days." [The last meeting between the parties was had on the 9th February, and the child was born on the 5th December, 1838.] After adverting to some medical authorities relative to gestation, he said: "He would rather believe that she had yielded to some other attempt on her chastity, than that so wide a departure from the usual course of nature had taken place." The jury did not concur in this view, and they returned a verdict for the plaintiff, thereby pronouncing an opinion which is well-borne out by medical experience, that the defendant might have been the father of the child, although forty-two weeks and five days had elapsed since the last access. (Lancet, Aug. 1840.)

Had the verdict been the other way, there would have been fair ground, medically speaking, for a new trial; for the summing up was undoubtedly made on a mistaken view of medical doctrines. It amounted to this, that the chastity of every woman who bore a child in the forty-third week of pregnancy was to be impeached,—and that the legitimacy of every such child was to be set aside, on bare proof of the fact; whereas, according to Dr. Merriman's table, out of one hundred and fourteen pregnancies—a limited number of cases—fifteen took place in the forty-second, and ten in the forty-third week. (See antè, p. 611.) This shows the risk to which the decision of such questions is exposed, when medical evidence is not called for on matters so strictly professional.

Great mistakes have arisen in the calculation of the period of gestation, by the use of the word month—some intending by this, lunar, and others calendar months. Nine lunar months would be equal to two hundred and fifty-two days, while the average of nine calendar months would be two hundred and seventy days—the latter period varying according to the particular months of the year over which the pregnancy might extend. To prevent such mistakes or that misunderstanding of evidence which has so frequently arisen, it would be advisable that medical witnesses should always express the period of gestation in weeks or days.

It will be seen from the foregoing cases, that in these suits the general practice consists in establishing possibility of access on the part of the husband;—when this is proved the medical question arises, whether the term of gestation falls within those limits assigned by the best medical experience. Legitimacy has been allowed where gestation was probably protracted to the *forty-third week,* (Anderton v. Gibbs,) and it has been disallowed where it was protracted to *forty-four weeks* and five days. (Gardner Peerage case.)

Paternity.—It has been stated that the law does not pretend to determine who begat the child when it is born during wedlock, and from circumstances might be the child either of the husband or an adulterer. But medical jurists have recommended that family likeness should be looked to on these occasions, not merely a likeness in feature and figure, but in gesture and other personal peculiarities which may have characterized the parent. These are called questions of paternity: they seldom occur, and when they do present themselves, the evidence thus procured, even if affirmative, is properly regarded as only corroborative. In the Townshend Peerage case lately brought before the House of Lords, (May, 1843,) this argument of family likeness was used and admitted by their lordships. The party whose legitimacy was in question, was sworn by one of the witnesses to bear so strong a likeness as a child to the alleged adulterer, that he should have known him among five hundred children. The proceedings in the Douglas Peerage case (1767) also show that evidence of this kind may have a strong influence on the decision of a case.

Two young men claimed the Douglas peerage after the death of their alleged parents, Sir John and Lady Douglas. The claim was disputed, on the ground that they were supposititious children. Much stress was laid in favour of their legitimacy, on the fact that they closely resembled—the one Sir John, and the other Lady Douglas. The resemblance was general,—it was evident both in their features, gestures and habits. Lord Mansfield, in delivering judgment, made the following remarks, which comprise all that can be said on the subject. "I have always considered likeness as an argument of a child being the son of a parent, and the rather as the distinction between individuals in the human species, is more discernible than between other animals. A man may survey ten thousand people before he sees two faces exactly alike, and in an army of a hundred thousand men, every man may be known from another. If there should be a likeness of feature, there may be a difference in the voice, gesture, or other characters; whereas a family likeness runs generally through all of these; for in everything there is a resemblance, as of feature, voice, attitude and action."

From this account it will be seen that evidence of this kind is not medico-legal,—it can only be furnished by friends and relatives who have known the parties well, and are competent to speak of the facts from personal acquaintance with them. It will also be apparent that the affirmative evidence in such cases will be stronger than that which is negative; for it could hardly be inferred that a person was illegitimate because he did not resemble his parent.

It has been supposed that a case of this kind might present itself on the marriage of a widow soon after the death of her first husband. If a child were born after the lapse of ten months, it might be a question whether it were a child of the first or second marriage; and although there might be no dispute concerning its legitimacy, yet it would be difficult to settle its paternity. Such a case appears hypothetical. In order that any doubt should exist, a widow must marry within, at the furthest, six weeks after the death of her first husband, or else the birth of the child would fall beyond the furthest limit of gestation so far as he was concerned. The customs of society are, however, a bar to such marriages; and admitting that a child was so born, that it might be the offspring of either husband, then the fact of its being born during the marriage of the second husband, would presumptively fix the offspring upon him, unless it could be shown that there was no possibility of access on his part. If there were a supposed greater likeness to the first than to the second husband, still this would not be allowed to defeat the legal presumption of the real parentage of the child. Evidence much stronger than this would be required for such a purpose. (See Henke Zeitschrift, 1838, ii. 432.)

Parental likeness may be occasionally indicated by colour or peculiarities belonging to the varieties of mankind, as of the intermixture of a Negro or Mongolian with one of the Caucasian variety. In such a case the evidence afforded becomes much stronger.

CHAPTER LXII.

SUPERFŒTATION. IMPOTENCY. STERILITY.

Superfœtation.—Most medico-legal writers, in treating of legitimacy, have considered it necessary to introduce the subject of superfœtation. By this we are to understand, that a second conception may follow the first, and that gestation may go on to its full period in each case, independently of the other,—so that if a woman were impregnated, when in the third month of gestation, she would bear the first child mature at the end of nine months, and the second child also mature at the end of twelve months after the first conception. This subject has been said to involve "not only the conjugal fidelity of a wife, but the disposition of property, and much of the comfort and happiness of society." Its importance to a medical jurist appears to me to have been here considerably exaggerated. So far as I have been able to ascertain, not only is there no legal case involving this question, to be met with in the juridical records of this country; but none in reference to this state is ever likely to occur which would present the least difficulty to a medical practitioner. If we admit that a woman may during marriage, present such an extraordinary deviation from the common course of nature, as to produce two perfectly mature and fully developed children, the one three or four months after the other, how can such an event be any imputation on her fidelity? Superfœtation, if it occur at all, may occur in married life, and during connubial intercourse.

The following appears to be the only possible case wherein a medical opinion might be required respecting this alleged phenomenon. A married woman, six months after the absence or death of her husband, gives birth to a mature child, which dies. Three months afterwards, and nine months after the absence or death of her husband, she may allege that she has given birth to another child also mature; a medical question may arise, whether two mature children could be so born, as that the birth of one should follow three months after the birth of the other,—or whether this might not be a case, by no means uncommon, of twin children, the one being born prematurely, and the other at the full period. Admitting that both the children were mature; and therefore that it was a case of superfœtation,—the first delivery must have taken place in the presence of witnesses,—and it would then have been known whether another child remained in the uterus or not. If the two children were born within the common period of gestation after the absence or death of her husband, then their legitimacy would be presumed, until the fact of non-access were clearly established. The mere circumstance of both of them being mature, and born at different periods would per se furnish no evidence of their illegitimacy. On the other hand, if one or both of them were born out of the ordinary period, then, according to the evidence given, they might or might not be pronounced illegitimate. The law then appears to have no sort of cognizance of the subject of superfœtation as such :—it is entirely merged in the question of protracted gestation, which has already been fully considered.

Whether superfœtation can really take place or not, is a question which has given rise to much controversy. That one conception may follow another within a short period, and that twins may thus be the result of two distinct conceptions, is a probable occurrence. But when gestation has already gone to the second month, it is highly improbable that there should be a second conception. Cases of alleged superfœtation appear readily explicable on the supposition that the woman was pregnant with twins, and that one was born prematurely, and the other at the full time, or later. For an instance of this kind, see Henke Zeitschrift der S. A. 1837. Even under a malformation which might be supposed to be favourable to its occurrence, namely, the presence of a bilocular uterus, it has been found that impregnation has sometimes taken place in one cornu only. (See Med. Gaz. xix. 507.) A singular instance is, however, recorded in the same journal (xx. 508), where a woman six months after marriage, bore a four months' child, and forty weeks after marriage mature twins. On examination, the uterus and vagina were both found double—each vagina had a separate orifice.

We have hitherto considered the subject of legitimacy in reference to the duration of gestation; but we have now to examine those cases in which the plea is, that the alleged parent laboured under physical incapacity. This may depend on age, on certain physical causes, or on congenital malformation or defect. To this condition, the term IMPOTENCY is applied in the male, and STERILITY in the female. We may first consider the causes to which impotency may be referred.

I. AGE.—The person may be so young as to render it impossible that he should be the father of a child imputed to him. Cases involving questions of legitimacy on this ground, are not heard of in the present day; but in ancient law-books there are decisions relative to the illegitimacy of children, born during marriage, because the alleged fathers were seven, six, and even three years old! (Amos.) The exact age at which the sexual function appears, differs in different individuals;—it is usual to say, that it does not exist until after the age of puberty (14), but this state does not always occur at the same period. A question relative to the power of individuals at this early age, may be put to a medical witness in reference to the affiliation of children. The following case occurred in 1840. A woman wished to affiliate a child on a youth, who was in his sixteenth year. The boy denied that he was the father of the child; and there was reason to suspect that the imputation had been wrongly thrown upon him, in order to divert suspicion from the real party. There was some difficulty in the case; but it appears to me that the rule for a medical man to follow on these occasions is this:—not to regard the mere age of the youth, whether he be above or below the average age of puberty, but to observe whether the sexual organs be fully developed, and whether there be about him any of the ordinary marks of virility, indicated by muscular development, the growth of a beard and a change in the voice. If these signs be present, whatever may be his age, there is strong reason to suppose that the sexual functions are developed. We occasionally hear of instances of extraordinary precocity; but the development of the sexual power is generally accompanied by other well-marked changes in the individual. One singular instance to the contrary is mentioned by Botta. (Athenæum, 1842, p. 3.)

On the other hand, it may be alleged, that the individual was so old that he must have been necessarily impotent through age. That impotency is one of the natural consequences of advanced age, is undoubted: but this, as we know, forms no legal impediment to the marriage of parties however old. The legal presumption is, that the generative faculty does not disappear through age; and if this be alleged, and legitimacy disputed on this ground, it must be satisfactorily proved. This amounts almost to an impossibility; because it is well known, that there is no particular age at which the sexual functions disappear either in the male or female; and individuals of both sexes who had passed the ages of sixty, seventy, and even eighty years, have been known to be prolific. The English law on this subject was clearly laid down in the Banbury peerage case, brought before the House of Lords many years since.

Lord and Lady Banbury had been married twenty-one years without having had issue, when his lordship died at the age of eighty years. The peerage was claimed by an individual, who called himself the son of Lord Banbury; but in fact it was alleged, that he was the son of Lady Banbury by an adulterer, during her husband's life. According to the evidence, Lord Banbury did not appear to be aware of his existence; and the child had always been known by another name. One of the grounds upon which the legitimacy of the descent of the claimant was contested, was, that the deceased nobleman was impotent through age; but it was then stated on good legal authority, that the law put no limit on the powers and faculties of man. The assumed impotency of the alleged parent on the ground of age, could never be admitted as a proof of the illegitimacy of the supposed offspring. The House decided against the claim, but not on the ground of the impotency of the ancestor from age.

Impotency may depend on moral causes, or on latent physical causes only discoverable after death, but with these a medical jurist has no concern; the law requires clear proof of the existence of some apparent and irremediable defect, in order to interfere in questions relative to legitimacy or divorce.

II. Disease, or accident.—The loss or destruction of any of the external organs, either by disease, accident, or from necessary operations, would be a sufficient ground to allege impotency. The loss of one or both testicles from any of these causes, would be indicated by the presence of distinct cicatrices in the scrotum. The loss of one testicle only does not render a man impotent;—monorchides have been known to be prolific. Cases of this kind must not be confounded with those, where one or both testicles have never descended into the scrotum. In some rare instances, the organs, do not descend at the usual period; but one or both may remain in the abdomen, or in the inguinal canals, and only descend some time after birth,—or one may be found in the scrotum, and the other remain in the abdomen. When one of the organs only has descended, there is no ground cæteris paribus to impute impotency. When neither has descended, the scrotum will be found empty, but all the other marks of virility may still be present. It has been said that in such cases, the testicles were congenitally defective, but this is an error. Dissection has clearly proved that they have merely not descended; and although remaining in the abdomen, there was no reason to believe that they were incapable of exercising their functions. This absence of the testicles is a state very rarely seen: there are three preparations of this kind in the museum of Guy's Hospital,—one of them taken from a gentleman who shot himself out of despondency at his supposed defective condition. These individuals have been called crypsorchides. Physiologists are in doubt whether impotency is a necessary attendant on a non-descent of the testicles:—the most probable opinion is, that it is not, because the usual signs of virility have appeared about the person. If, in a case of non-descent, there should be a non-development of the external organs, and this is accompanied by a total want of the characters of virility, no doubt can be entertained, that the individual is irremediably impotent.

III. Congenital defect, or malformation.—To this condition, the term hermaphroditism has been applied: it should rather be called sexual malformation or monstrosity. Owing to arrested development, during the growth of the fœtus, the sexual organs, which can scarcely be distinguished at the fourth month, occasionally assume a certain abnormal arrangement. The sexes appear to be more or less mixed, and sometimes the male, and at others, the female characters predominate. In the former case, these beings are called androgyni, and in the latter androgynæ. With this defective sexual development, the other peculiarities of the sexes are wanting, or we find them more or less blended. Thus, in an androgynus the general figure of the body may be that of a female,—the male voice is wanting, and there is no beard:—on the other hand, in the androgyna, there may be a predominance of the male characters. There can be no difficulty in identifying such cases, and a medical jurist can have no hesitation in pronouncing these subjects to be incurably impotent,—the organs are so commonly defective as to be wholly unfitted for the functions of either sex. It is not meant to be said, that it is in all cases easy to assign the sex, but that is of minor importance,—the main question being, whether the malformation be or be not such as to justify divorce, or the imputation of illegitimacy upon children claiming to be the offspring of these beings. One of the most remarkable of these sexual monsters, died in 1835, at the age of 55, and was examined by Prof. Mayer of Bonn. In general there is defective development of either the male or the female organs, but in this case there was a real approach to hermaphroditism;—the defective sexual organs on the right side, belonging to the male, and those on the left belonging to the female. The general configuration of the body was that of a woman. (See Med. Gaz. xix. 135.)

The determination of the sex in these cases of deformity has been considered to be necessary under certain circumstances, as when, for instance, a title or entailed inheritance of lands is in question. Lord Coke has stated, that according to the law of England, an hermaphrodite may be either male or female, and it shall succeed according to the kind of sex which is predominant. Thus it is obvious, that the law will decide each case according to the special circumstances attending it. Sexual monstrosity, although it may lead to suits of divorce and legitimacy, is not a ground for depriving the being of the rights of inheritance.

According to Chitty (M. J. 373) the calling a person an hermaphrodite is not actionable, unless it is proved to have been attended with some special damage. A case was tried, in which a dancing-master brought an action against a party for calling him an hermaphrodite; and it was decided that it was not sustainable: 1. Because such union of the sexes cannot exist in fact; and every one must be supposed to know it,—consequently the assertion could not be supposed to prejudice. 2. Because, admitting the possibility of such double function, the party would be just as good, and perhaps even a safer dancing-master, than if only one perfect sex had been discoverable—consequently the words would not, in legal presumption, injure him in his profession, or occupation!

In the Townshend peerage case, lately decided (1843) the legitimacy of one claimant was denied on account of the impotency of the alleged parent, whether from congenital defect or otherwise, no evidence was given to show. The illegitimacy was established by proof of non-access on the part of the husband, without reference to his alleged impotency.

Sterility.—The causes of sterility in the female system are very numerous. Some of them depend upon peculiarities of constitution, the sexual organs being well formed and developed,—others upon latent changes or congenital defects in the uterus and its appendages, only discoverable by an examination after death. This condition of the female rarely becomes a medical question in contested cases of legitimacy; for a claim on the part of an individual to be the offspring of a particular woman, unless the female herself were in collusion with the claimant, could only be made after her death; and if not disproved by medical evidence, showing that the woman could not have borne children, it would in general be easily set aside by circumstances. If the uterus, ovaries, or other parts, were congenitally absent, or if there were external sexual malformation, accompanied by occlusion or obliteration of the vagina, a medical witness could have no difficulty in saying that the woman must have been sterile. A mere occlusion of the vagina, removable by operation, does not always indicate sterility, for the internal parts may be healthy and sound. In some instances, the uterus may be entirely absent, a fact which cannot be always determined during life. On the whole, the physical and irremediable causes of sterility in the female, are not so apparent as in the male; because in the former, the generative apparatus is placed internally; and slight changes in its various parts, sufficient to produce permanent sterility, cannot be determined by an examination.

With respect to AGE.—The sexual functions in a female are regulated by the catamenia, so that it is commonly asserted that females cannot become impregnated either before or after these have ceased to appear. As a general principle, this may be true; but a case has been elsewhere related (PREGNANCY, antè p. 581), where a woman became pregnant who had not up to that time menstruated, and in another instance, a woman aged 44, in whom the discharge had entirely ceased for seven months, became pregnant. Some females are very precocious and may conceive at a very early period of life; but then it will commonly be found that the menses have appeared early. Others will bear children at the age of sixty, and upwards—in short, it has been already stated that sterility cannot be presumed to exist from mere age.

There is another point of view in which these defective states of the sexual organs may come under the consideration of a medical jurist, namely, where they are made grounds for a divorce. To justify this, the impediment to intercourse or procreation must be apparent and irremediable; it must also have existed before the marriage of the parties, and have been entirely unknown to the person suing for the divorce. The nature of the impediment is commonly determined by private medical opinions or affidavits. A divorce granted under these circumstances is total, i. e. "*a vinculo matrimonii.*" There is one remarkable circumstance with respect to these cases, namely, that in nearly all of them, the suit is by the female against the male; although there is no reason whatever to suppose that impotence and sexual malformation, are more common in males than sterility in females. We never hear of a man instituting a suit of divorce on the ground of sterility in the wife; it is, I believe, in most instances, that the wife promotes the suit on the ground of impotency in the husband. The difficulty of establishing sterility, and the facility of proving impotency in many cases, may account for the difference. Suits of this kind are sometimes instituted many months and years after the union of the parties; but it is pretty certain that the desire for separation in these cases often depends on some other cause, which the law would not recognise as sufficient of itself, while it would admit the plea of impotency. The French law very judiciously applies the principle of condonation to such cases, so that no suit for nullity of marriage can be entertained, if cohabitation have continued for six months after the discovery of the personal defect. This appears to be more consistent with justice, than that of our own law: but practically these suits after protracted cohabitation, are regarded with much suspicion. The nature of the medical evidence required on these occasions, will be best understood by the following extract from Oughton:—"Ad probandum defectus judex compellere potest virum ad exhibendum præsentiam suam et ad ostendendum in aliquo loco secreto (per judicem assignando) pudenda sua, seu illos corporis defectus quos mulier objicit (si ex inspectione corporis apparere possint) medicis et chirurgis peritis prius judicialiter in præsentiâ partis adversæ de diligenter inspiciendo virum et de referendo in scriptis eorum judicium juratis. Et si medicorum et chirurgorum judicium sit quod morbus vel defectus viri fuerit insanabilis et incurabilis (tamen tenentur in relatione eorum judici ipsum morbum seu defectum specificare ne circumveniatur Ecclesia) et quod in eorum scientiâ doctrinâ experientiâ morbus aut defectus hujusmodi nullâ re aut arte medicâ curari possit mulier obtinebit in causâ: Hoc addito et allegato ex parte mulieris quod ipsa sit juvenis et ad procreationem apta et quod per tres annos insimul pernoctarunt et quod quamvis a marito cognosci cupiebat ab eo tamen cognita non fuit nec cognosci potuit!"

INSANITY.

CHAPTER LXIII.

UNSOUNDNESS OF MIND. FORMS OF INSANITY.

THE law of England recognizes two states of mental disorder or alienation. 1. *Dementia naturalis,* corresponding to idiocy, and 2. *Dementia adventitia,* signifying general insanity, as it occurs in individuals who have once enjoyed reasoning power. To this state the term lunacy is also applied from a supposed influence exercised by the moon on the mind. Lunacy is a term generally applied by lawyers to all those disordered states of the mind which are known to medical men under the names of mania, monomania and dementia, and which are generally accompanied by lucid intervals.

The main character of insanity, in a legal view, is said to be the existence of delusion, i. e. that a person should believe something to exist which does not exist, and that he should act upon that belief. Many persons may labour under harmless delusions, and still be fitted for their social duties, but should these be such as to lead them to injure themselves or others in person or property, then the case is considered to require legal interference,—otherwise not.

Besides the terms Idiocy and Lunacy, we find another frequently employed in legal proceedings, namely "unsound mind"—(non compos mentis)—of the exact meaning of which it is impossible to give a consistent definition. From various legal decisions, it would appear that the test for unsoundness of mind in law has no immediate reference to the mere existence of delusion, so much as to proof of incapacity in the person, from some morbid condition of intellect, to manage his affairs. (Amos.) Neither condition will suffice to establish unsoundness without the other; for the intellect may be in a morbid state, and yet there may be no legal incompetency, or the incompetency alone may exist and depend on bodily infirmity, or want of education, a condition which must not be confounded with insanity. Thus then a person may be of unsound mind, i. e. legally incompetent to the control of his property, and yet not come up to the strict legal standard of lunacy or idiocy. Hence it will be seen that it is impossible in medical jurisprudence to give any consistent definition of insanity. A medical witness who ventures upon a definition, will generally find himself involved in numerous inconsistencies. No words can comprise the variable characters which this malady is liable to assume.

Some medical practitioners have attempted to draw a distinction between insanity and unsoundness of mind. A case occurred in 1839, where a medical man hesitated to sign a certificate for the confinement of an alleged lunatic; because in it, the terms "unsound mind" were used. He said he would not have hesitated to sign it, had the term "insane" been substituted. The difference, if any exist, is purely arbitrary, and depends on the fact, that unsound mind is a legal and not a medical phrase, referring to an incapacity to manage affairs, which insanity in its most enlarged sense may not always imply. The law, however, appears to admit some sort of distinction; for, according to Chitty, it is a criminal and an indictable act maliciously to publish that any person is afflicted with insanity, since it imputes to the party a malady generally inducing mankind to shun his society; although it is not libellous to say that a man is not of sound mind, because no one is of perfectly sound mind but the Deity! (M. J. i. 351.) In reference to the refusal to sign certificates, it is however an error to suppose that the use of one term can involve a practitioner in a greater share of responsibility than the other.

Medical jurists have commonly treated insanity under four distinct forms: Mania, Monomania, Dementia and Idiocy. This division was proposed by Esquirol; and although of a purely artificial nature, it is highly convenient for the arrangement and classification of the facts connected with the subject. In some instances, there is great difficulty in assigning a particular case to either of these divisions, which is owing to the circumstance that these states of mind are frequently intermixed, and are apt to pass and repass into each other. On other occasions, a case may present characters which appertain to all the divisions. Some psychologists have proposed two subdivisions;—namely, Incoherency and Imbecility, but the former is merely a mixed state of mania and dementia, while the latter is a term applied to those cases of idiocy, wherein the mental faculties are more or less susceptible of cultivation after birth, without reaching the normal standard. In a work on Medical Jurisprudence it will only be necessary to state briefly the principal features of each of these varieties of insanity. For a more full account, I must refer the reader to the well known treatises of Esquirol, Marc and Prichard.

MANIA.—In this form of insanity there is general derangement of the mental faculties, accompanied by greater or less excitement, sometimes amounting to violent fury. The individual is subject to hallucinations and illusions, the difference in the meaning of which terms, it may be here proper to explain. Hallucinations are those sensations which are supposed by the patient to be produced by external impressions; although no material objects act upon the senses at the time. Illusions are sensations produced by the false perception of objects. (Marc.) When a man fancies he hears voices while there is profound silence, he labours under a hallucination: when another imagines that his ordinary food has an earthy or metallic taste, this is an illusion. Illusions sometimes arise from internal sensations, and give rise to the most singular ideas. When a hallucination or illusion is believed to have a real and positive existence, and this belief is not removed either by reflection or an appeal to the other senses, the individual is said to labour under a delusion: but when the false sensation is immediately detected, and is not acted on as if it were real, then the person is sane. Perhaps this is the most striking distinction which it is in our power to draw between sanity and insanity. The acts of the insane are generally connected with their delusions; but it is extremely difficult to trace the connection between them except by their own confession. It has been remarked that in mania there is great insensibility to changes of temperature; but it must not be inferred from this, that the patient is less susceptible than a sane person of the injurious effects of cold. The bodily susceptibility of insane persons is just as great, while they want that warning power, which the sense of feeling gives to one who is sane.

It is necessary that a medical jurist should be able to distinguish mania from delirium depending on bodily disease. Delirium very closely resembles the acute form of mania, so closely that mistakes have occurred, and persons labouring under it have been ordered into confinement as maniacs. The following are perhaps the best diagnostic differences. A disordered state of the mind is the first symptom remarked in mania, while delirium is a result of bodily disease,—there is also greater febrile excitement than in mania. Delirium being a mere symptom attendant on the disease which produces it, exists so long as that disease, and no longer; while mania, depending on very different causes, is persistent. Delirium disappears suddenly, leaving the mind clear, while mania commonly experiences only remissions. (See Pagan, Med. J. of Ins. 69.)

Monomania.—This name is applied to that form of insanity in which the mental alienation is partial. The delusion is said to be confined to one subject or to one class of subjects. One fact is well ascertained, that it varies much in degree:—for many persons affected with monomania, are able to direct their minds with reason and propriety to the performance of their social duties, so long as these do not involve any of the subjects of their delusions. Further, they have occasionally an extraordinary power of controlling their thoughts and emotions, and concealing the delusions under which they labour. This implies a consciousness of their condition, not met with in mania; and it also appears to imply such a power of self-control over their thoughts and actions, as to render them equally responsible with a sane person for many of their acts. In a real case of monomania, it is not to be supposed that a man is insane upon one point only, and sane upon all other matters. The only admissible view of this disorder, is that which was taken by Lord Lyndhurst, in one of his judgments. In monomania, the mind is unsound;—not unsound in one point only, and sound in all other respects, but this unsoundness manifests itself principally with reference to some particular object or person. (Prichard.) There is no doubt that all the mental faculties are more or less affected; but the affection is more strikingly manifested in some, than in others. Monomania is very liable to be confounded with eccentricity:—but there is this difference between them. In monomania, there is obviously a change of character, the individual is different to what he was: in eccentricity, such a difference is not remarked:—he is, and always has been, singular in his ideas and actions. An eccentric man may be convinced, that what he is doing, is absurd and contrary to the general rules of society, but he professes to set these at defiance. A true monomaniac cannot be convinced of his error, and he thinks that his acts are consistent with reason and the general conduct of mankind. Eccentric habits suddenly acquired are, however, presumptive of insanity. It will be seen hereafter that the diagnosis is of some importance in relation to the testamentary capacity of individuals.

Most medico-legal writers admit that insanity is not necessarily confined to the intellectual powers; but that it may also show itself without decided intellectual aberration in the feelings, passions and emotions. Thus it may appear under the form of a causeless suspicion, jealousy, or hatred of others, especially of those, to whom the individual ought to be attached; and it may also manifest itself under the form of a wild, reckless and cruel disposition. This is what has been called by Dr. Prichard, "Moral insanity," to distinguish it from the other form affecting the mental powers, namely, "Intellectual insanity." It is, however, very doubtful whether moral insanity ever exists in any individual without greater or less disturbance of the intellectual faculties. The mental powers are rarely disordered without the moral feelings partaking of the disorder: and conversely it is not to be expected that the moral feelings should become to any extent perverted without affecting the intellect. The intellectual disturbance may be difficult of detection; but in every case of true insanity there is no doubt that it exists, and it appears to me that it would be a dangerous rule to pronounce a man insane where it does not obviously exist. The law does not at present recognize insanity of the affections only: hence, however perverted these may be, a medical jurist must look for some indications of intellectual disturbance.

Monomania may be accompanied with a propensity to homicide or suicide; and according to many psychologists, with a disposition to incendiarism or theft. These forms will be referred to hereafter in speaking of the criminal responsibility of the insane.

Dementia.—In this state there is a total absence of all reasoning power;—the mental faculties are not perverted, but destroyed. There is a want of memory as well as a want of consciousness on the part of the individual, of what he does or says. It is by no means an unfrequent consequence of mania or monomania,—but it has been known to occur suddenly in individuals, as an effect of a strong moral shock.

Idiocy.—Idiocy is characterized by the want of mental power, being congenital. While mania, monomania, and dementia, form the "dementia accidentalis," idiocy forms the "dementia naturalis" of lawyers. This intellectual deficiency is marked by a peculiar physiognomy, an absence of all expression, and a vague and unmeaning look, whereby an idiot may in general be clearly identified. In some cases of congenital deficiency, the mind is capable of receiving a few ideas, and of profiting to a certain extent by instruction. To this state the term Imbecility is applied. It may be regarded as a minor degree of idiocy. The minds of imbeciles can never be brought to a healthy standard of intellect, like that of an ordinary person of the same age. The degree to which congenital deficiency of intellect exists, is generally well marked by the power of speech, or of communicating ideas by language. In idiocy there is no speech, or only an utterance of single words :—in the better class of imbeciles, the speech is but little affected : while there is every grade between these two extremes. Some medical jurists have arranged imbeciles in classes, according to their capacity to receive instruction ;—others according to their power of speech : but such divisions are practically without value,—each case must be judged of by itself. It is by no means easy to draw a distinction between the better classes of imbeciles and those who are reputed sane,—since the minds of sane persons differ remarkably in their power to receive instruction. In has been well observed, that by endeavouring to make a very close distinction of this kind, one half of the world might reason itself into the right of confining the other half, as insane!

Persons affected with idiocy and imbecility do not suffer from hallucinations and illusions, like those who labour under mania or monomania. Idiots and imbeciles are what they always have been : there is no gradual loss or impairment of the intellectual functions. The term imbecility is often applied to that loss of mental power, which takes place as a result of extreme age : but this is with greater propriety called senile dementia.

Such are the forms under which insanity or mental alienation presents itself to our notice. This classification has been adopted for the sake of convenience, because by it, a practitioner may be led to form a safe diagnosis of the real state of mind of a person. It is not recognized in any of the law-proceedings connected with the insane :—for here the term unsoundness of mind, comprehending lunacy and idiocy, is almost exclusively employed. In adopting this arrangement, a medical jurist must take care not to fall into an error which has been sometimes committed, i. e. of pronouncing a person to be of sound mind, because his case could not be easily placed in any one of these four great divisions of insanity. This would be as serious an error as that formerly committed by some law-writers,—namely, of giving restricted and inappropriate definitions to lunacy and idiocy, and then con: tending that, whoever was not a lunatic or idiot according to these arbitrary legal definitions, must be a person of sound mind.

The *hereditary transmission* of the malady has sometimes presented itself as a medico-legal question in relation to the criminal responsibility of the insane. According to Chitty, it is an established rule of law, "that proof that other members of the same family have decidedly been insane, is not admissible either in civil or criminal cases." (Med. Jur. i. 352.) Such an exclusion, if rigorously insisted on, would be manifestly inhumane, supposing that our law-authorities really desired to throw any light upon the existence of insanity in a doubtful case; and there is no doubt that a strong medical opinion on the point, would suffice to remove from the minds of most judges, any difficulty to its admission. In making a diagnosis of a case of insanity medically, one of the first questions put, is commonly in reference to the present or past existence of the disorder in other members of the family. There can be no doubt, from the concurrent testimony of many writers on insanity, that a predisposition to the disease is frequently transmitted from parent to child through many generations. The malady may not always show itself in such cases; because the offspring may pass through life without being exposed to any exciting cause: but in general it readily supervenes from very slight causes. M. Esquirol has remarked that this hereditary taint is the most common of all the causes to which insanity can be referred, more especially as it exists among the higher classes of society. Among the poor, about one sixth of all the cases may be traced to this hereditary taint; and other authorities have asserted that in more than one half of all cases of insanity, no other cause can be found for the malady. As we might suppose,—children which are born before insanity manifests itself in the parents, are less subject to the disorder than those born afterwards. When one parent only is insane, there is less tendency for the predisposition to be transmitted, than when both are affected; but according to Esquirol, this predisposition is much more readily transmitted through the female than through the male parent. Its transmission is also more strikingly remarked when it has been observed to exist in several generations of lineal ancestors;—and like other hereditary maladies, it appears to be subject to atavism; i. e. it may disappear in one generation and reappear in the next. Further, the children of drunken parents and of those who have been married late in life, are said to be more subject to insanity, than those born under other circumstances. When insanity is transmitted by hereditary descent, it appears often about the same age, under the same form, and is induced by the same exciting cause in the offspring as in the parent. This it is proper for a medical jurist to bear in mind, in examining a plea of insanity in criminal cases. The valuable tables of Esquirol show that the age at which insanity most commonly attacks persons is thirty:—it rarely makes its appearance below the age of twenty or above the age of fifty-five.

Feigned Insanity.—Insanity is frequently feigned by persons accused of criminal offences, in order to procure an acquittal or discharge. In the first place, when this is suspected, it will be proper to inquire, whether the party have any motive for feigning the malady. It is necessary to remember that insanity is never assumed until after the commission of a crime and the actual detection of the criminal. No one feigns insanity merely to avoid suspicion. In general, as in most cases of imposture, the part is overacted—the person does too much or too little, and betrays himself by inconsistencies of conduct and language, never met with in real cases of insanity. There is commonly some probable cause to which insanity may be traced, but when the malady is feigned, there is no apparent cause:—in this case also, the appearance of the assumed insanity is always sudden:—in the real malady, the progress of the attack is commonly gradual, and when the attack is really sudden, then it will be found to be due to some great moral shock or other very obvious cause. We should observe whether there has been any marked change of character in the individual, or whether his conduct, when he had no interest to feign, was such as it is now observed to be. Some difficulty may arise when fits of eccentricity or strangeness of character, are deposed to by witnesses; but these statements may be inconsistent with each other, and his previous actions may bear no resemblance whatever, to those performed by him in the recently assumed condition. A difficulty of this kind rarely presents itself, since in an impostor, no act indicative of insanity can be adduced for any previous period of his life: it is only after the perpetration of a crime, and its detection, that any acts approaching to insane habits, will be met with. In real insanity, the person will not admit that he is insane;—in the feigned state all his attempts are directed to make you believe that he is mad:—if told that he is insane, he does not contradict you; and an impostor may be induced to perform any act, if it be casually observed to another in his presence that the performance of such an act will furnish still stronger evidence of his insanity.

Mania is perhaps more frequently assumed than any other form, because the vulgar notion of insanity is, that it is made up of violent action and vociferous and incoherent language: but mania rarely comes on suddenly, or without an obvious cause:—the patient is also equally furious night and day, while the impostor is obliged to rest after his violent exertions. In mania the person sleeps but little, and the sleep is disturbed:—an impostor sleeps as soundly as a healthy individual:—the violence of the maniac continues whether he is alone or not, while the impostor acts his part only when he thinks he is observed: hence the imposition may be detected by watching him, when he is not aware that any eye is directed upon him.

Some stress has been laid on the fact that assumed insanity commonly appears suddenly and without probable cause; but while this may be allowed to have a general value in forming a diagnosis, it is proper to bear in mind that the actual commission of a crime has sometimes suddenly led to an attack of mania in a previously sane person. Dr. Pagan has related a very singular instance of this kind.

Two men were committed to prison on a charge of theft, and the officers requested a poor man, who was a shoemaker, to assist them in conveying the prisoners. This man took a gun with him for better security. During the journey one of the prisoners leaped from the cart and ran off. The officers called to their assistant to fire, and he thinking himself warranted to do so, fired, and wounded the prisoner severely in the back and loins. The man who fired the gun was himself immediately committed to gaol as a criminal, and the event made such an impression upon him, that he became violently maniacal. When scarcely recovered he was tried for the offence; and it was supposed that he was feigning insanity. He was convicted and sentenced to six months imprisonment. (Med. Jur. of Ins. 82.) This case proves that a person may really be attacked by mania under circumstances, in which a justifiable suspicion might arise that he was feigning.

The feigning of monomania would be a matter of some difficulty, and easily susceptible of detection. Dementia is more easily feigned:—in general this state comes on slowly, and is obviously dependent on organic changes, as old age, apoplexy, paralysis or hemiplegia, or it is a consequence of long-continued mania or monomania. As this form of insanity consists in an entire abolition of all mental power, so the discovery of any connected ideas, reasoning or reflection either by language or gestures, would at once show that the case was not one of real dementia. Idiocy and imbecility could hardly be feigned successfully, because these are states of congenital deficiency; and it would be easy to show, by reference to the past life of a person, whether or not he had always been such as he represents himself. The difficult cases of feigned insanity are really limited to those forms of the malady which are liable to attack an individual suddenly. In a sudden attack of real insanity, there should be some obvious cause:—the non-existence of this with the presence of a strong motive for deception, will always justify a suspicion that the malady has been assumed.

The following is a case of feigned insanity which was the subject of a trial in London, in 1833. A married woman, aged fifty, was charged with uttering a forged cheque:—she had craftily procured the signature of a person under a false pretence, and then forged his name to the cheque. When required to plead she made no answer, and appeared unconscious of the question. She took up some flowers placed in the dock, and crumbled them in her fingers, which were in continual motion. She stared wildly at times, changing her position,—turned her back on the court,—muttered indistinct exclamations and made a humming noise. She was placed under some restraint in order to prevent her jumping out of the dock. The first question which the jury were directed to try, was whether she were of "sound mind or not,"—it being a rule of law, that no insane person can be called on to plead to an offence committed by him. Evidence was then adduced to show, that at previous periods of her life she had used incoherent language, and was strange in her conduct. It was also shown that her mother, aunt, and sister, had been insane. Dr. Uwins deposed that at first he thought the prisoner was feigning ; for she appeared to be fully aware of the importance of a plea of insanity, but when he heard that other members of her family had had the disease, he was induced to think her insane, and not accountable for her actions. Another medical witness, who had attended her family professionally, and had known the prisoner long, thought she was not insane, although he allowed that the apprehension of a criminal charge might bring on an attack of insanity in a mind subject to aberration. Other witnesses deposed that they had never observed any acts of insanity about her ; and it was further proved that she was well acquainted with the method of drawing and procuring money on bills. When arrested, she tried to escape from the officer and conceal the money which she had procured by means of the forged cheque. The surgeon of the gaol thought she was feigning : he visited her daily, and he observed that her manner was changed so soon as she saw him. When asked what counsel she would employ, she returned a rational answer, saying that " others would take care of that :" when charged with feigning she made no observation. She put on a wild look when she knew she was observed ; but when privately watched, her behaviour was that of a rational person :—she generally slept soundly. The jury returned that she was of sound mind. She was then called on to plead to the charge, but she refused, —a circumstance rarely observed in the conduct of a really insane person. She was tried and found guilty of the charge.

There could be no reasonable doubt that this woman was an impostress, and that she feigned insanity, well knowing what would be the result of the plea, if admitted. Two circumstances rather tended to complicate the case : 1. the proof of hereditary predisposition : 2. her assumed silence, whereby she did not easily betray herself. In regard to hereditary predisposition, although valuable as collateral evidence, it cannot, of course, be allowed to outweigh general facts indicative of perfect sanity.

CHAPTER LXIV.

RESTRAINT. INTERDICTION. LUCID INTERVALS.

Among the questions which may come before a medical jurist, in relation to the subject of insanity, are the following : A practitioner may be required to say whether or not a person affected with the malady should be confined in a lunatic asylum,—whether he should be deprived of his civil rights by interdiction, or whether he be so completely cured of his malady, as to justify his liberation from confinement. Then, again, medical evidence may go far to determine whether a will or deed, executed by an alleged lunatic, should be set aside ; whether a marriage-contract should be annulled ; and lastly, whether a criminal act was committed by a person labouring under insanity,—a question involving either the life or, according to circumstances, the perpetual imprisonment of an accused party.

Restraint.—By this we are to understand the separation of the lunatic with or without the confinement of his person by force,—and the point to be considered is : What are the circumstances which will justify a practitioner in applying restraint to the insane ? The law has given great power in this respect to members of the medical profession, but owing to certain abuses, this power has been of late years much restricted by various acts of the legislature. Most medico-legal writers agree, that we are never justified in ordering restraint, except when from the symptoms, we have reason to apprehend that the lunatic will injure his person or property, or the persons or property of others. It is not then sufficient to seek merely for evidence of delusion : but if we discover that the individual labours under some delusion, it is our business to consider how far that may endanger the well-being of himself and his friends. Unless the delusion be such as to render it probable that his own interests or those of others, may be damaged by his insane conduct, careful and judicious superintendence will answer all the purposes of the closest restraint. Some have justified the act of resorting to restraint on all occasions, on the principle that it may tend to the cure of a patient by removing the delusion. In this point of view, the subject has no relation to legal medicine. It may be urged with more plausibility, that by withholding restraint in incipient cases, mischief may be done by the lunatic to himself or others; and then it will be too late to interfere; but even here proper superintendence will render close confinement unnecessary. A medical practitioner must not be too ready to lend himself to the signing of certificates for the close imprisonment of persons, who may be labouring under harmless delusions. In violent mania, or in monomania with a homicidal or a suicidal propensity, there can be no doubt of the propriety of applying some degree of restraint, for here the necessity is imminent. If a remarkable change has taken place in the character of the patient; if he has become irritable, outrageous or threatened personal violence, to any one, or if he has recklessly endangered the interests of himself and family, he is undoubtedly a fit subject for restraint. (See Pagan, 75.) The more he approaches to this condition, the less difficulty shall we have in coming to a decision, and in a really doubtful instance, there will be no impropriety in employing restraint; since although the person is thereby deprived of liberty, it is better that this should happen, than that he or his friends should incur the risk of suffering severely by his insane conduct.

Violence of temper must not be taken as a proof of insanity. A man may have always had a violent temper, subject to occasional fits of aggravation :—this must not be confounded with mental disease. In order to determine whether the acts be due to violent temper or insanity, it will be proper to ascertain what may have been the natural habits of the party. The great feature of insanity is change of character : a man who is really insane is different to what he has previously been ; but it may be proved of a violent-tempered man, that he has always been the same. The greatest abuses of the restraint-system have been chiefly observed in respect to monomania, where individuals have been forcibly imprisoned because they entertained some absurd delusion, over which, however, they had so great a power of control, as to render it somewhat difficult for a shrewd and experienced examiner to detect them. When, at last, after many hours' cross-examination, the existence of delusion has been made apparent, the result has been looked upon as furnishing matter for triumph and exultation; but as Dr. Conolly justly remarks, one point in these cases appears to have been wholly lost sight of, namely,—What possible injury could have resulted to the patient or his friends from the existence of a delusion, over which he had such complete control and mastery as to render it a most laborious task to obtain any evidence of its presence? (Indic. of Ins.) It may be freely admitted, that where such a delusion does exist, there is reason to suppose that the mind must be more or less disordered in all of its faculties; but such patients require close watching, not a rigorous imprisonment. The greatest danger is to be apprehended in all those cases, where there is the least power of self-control.

It will be here necessary to state the circumstances which require the attention of a practitioner when he is called upon to sign a certificate of insanity, whereby a person may be placed in confinement in an asylum. The act which specially refers to this subject is the 2d and 3d William IV., c. cvii., s. 28, 29, the provisions of which have been renewed by some subsequent statutes.

According to section 28, every medical certificate containing an order for the confinement of any person (not being a parish pauper) in a licensed asylum, shall be signed by *two* medical practitioners, not being in partnership, and each of them being a physician, surgeon, or apothecary, who shall have *separately* visited and *personally* examined the patient to whom it relates, not more than *seven* clear days previous to such confinement: and such certificate shall be signed and dated on the day on which the examination has taken place, and shall state that such person is insane and proper to be confined. In a case of emergency, one signature will suffice, provided the patient be seen and the certificate signed by another practitioner within seven days after the admission of the patient. Any person who shall knowingly and with a wilful intention to deceive, sign any such medical certificate, shall be deemed guilty of a misdemeanor. It is also a like offence for any practitioner to sign a certificate, who has any interest whatever in the asylum, as proprietor or professional attendant, or whose father, son, brother or partner is wholly or in part proprietor or professional attendant.

The form of certificate will be found in the schedule of the act. The signature of one practitioner only is sufficient for the reception of a pauper patient under a magistrate's order; but the certificate is drawn up in a different form.

As ignorance of the law is never allowed to be an excuse for its violation, so a medical man, unless acquainted with all the particulars above-mentioned, may easily subject himself to a prosecution; and he is not likely to be spared the disgrace and mortification attendant upon this, should it so happen that the case is of a doubtful nature. The law expressly requires from each medical man, a separate visit and a separate personal examination of the alleged lunatic. More than one medical practitioner has been convicted of a misdemeanour under this act since it was passed.

Discharge of lunatics.—In forming an opinion relative to the propriety of discharging a person, who has once been confined as a lunatic in an asylum, it is proper to examine the particulars of his case, with the same caution as if the object were to confine him for the first time. The question of liberation is commonly restricted, like that of restraint, to cases of mania and monomania. It may so happen, that an individual has a lucid interval at the time of examination, in which case, it will be necessary to make more than one visit. One who has been guilty of a heinous crime like murder, should never, on any pretence, be discharged. There are often long lucid intervals in homicidal mania; and it is impossible to be certain that the disease is entirely removed. If the individual has manifested the least disposition to suicide, we should be extremely cautious of liberating him; for suicidal mania is often artfully concealed under a cheerful exterior. We cannot always test the propriety of granting liberation by the lightness of the offence for which a criminal lunatic has been confined. The circumstances under which the most trifling offence has been committed, may show that the mind is wholly unsettled with regard to moral responsibility; and such lunatics can never be trusted, even when there is great improvement in their language and deportment. The unhappy result of prematurely discharging a criminal lunatic, was seen in the case of a man named Thom, otherwise styling himself Sir William Courtenay. He was shot while rioting with many others near Canterbury in June 1838. The whole life of this man seems to have been made up of a mixture of eccentricity and insanity. He was guilty of the most flagrant perjury, was tried, found insane and confined as a lunatic. After the lapse of about six months, it was thought that he was so much improved as to allow of his discharge; although even at this time, it appears that he fancied himself to be the Saviour. On his discharge, he was guilty of many extravagant acts; he collected a number of ignorant persons as his followers, and infected them with his delusion. He resisted the military who were sent to apprehend him, and eleven lives were lost on the occasion. A medical man cannot always be responsible for unfortunate consequences of this kind; but this and other similar instances show that great risk is incurred in hastily allowing of the discharge of a lunatic, who has once been guilty of a crime, however slight, so palpably depending on a disordered mind.

INTERDICTION.—By interdiction we are to understand the depriving a person labouring under mental disorder, of his civil rights; in other words, preventing him from exercising any control or management over his affairs. It may be with or without restraint, for one condition does not necessarily imply the other.

When an individual, from mental incompetency, is liable to be imposed upon by others, or is guilty of foolish and extravagant acts, whereby his property is damaged, a commission is commonly granted by the Court of Chancery, in order to determine, whether he be "*compos*" or "*non compos mentis.*" This writ is well-known under the name of "*de lunatico inquirendo.*" It has been already explained that the object of the law, is to determine whether the incapacity to manage affairs, be owing to some mental defect or disorder, and not merely to want of education or bodily infirmity,—otherwise all wealthy minors and infirm persons might be improperly deprived of the control of their affairs. It is unfortunate that these commissions are conducted on so expensive a scale, as to render them only applicable to the wealthy classes of society; and even here the expenses attending such a simple inquiry as that for which the commission is issued, are often of the most ruinous kind, and the results are by no means satisfactory. (See the cases of Mr. Davies, Miss Bagster and others.) When insanity is pleaded in a criminal case, one judge and twelve jurors will decide the question, affecting as it does the life of a party, in a few hours and at very little expense; it is difficult to understand why in a question of competency to manage affairs, so many more functionaries should be required, so much more time, sometimes amounting to twelve or fifteen days, occupied, so many witnesses examined, and such enormous expenses should be thereby incurred. (See cases of Lady Kirkwall, Feb. 1836, and of Miss Bagster, July 1832.) One source of difficulty on these occasions is, that medical witnesses are allowed to be summoned by both the parties, and the opinions given, often exactly neutralize each other; they are hereby converted into partisans in the cause, as much so as if they were counsel. It has been well remarked, that a man, even unknown to himself, with the purest intentions and the most perfect rectitude, will insensibly lean to the side on which he has been employed. (Pagan, 301.) The public are apt to infer from such conflicting opinions being given by men of equal experience, that the difference cannot depend essentially on the medical facts of the case; and that the question might be better determined by non-professional persons. A remedy for this serious evil would be, that medical witnesses on such occasions should be appointed, like the commissioners, by the Chancellor, and they would be thereby made equally independent of both parties. At present they rather occupy the position of medical counsel than medical witnesses; for it is quite clear, that not one would be summoned, whose opinion did not coincide exactly with that of the party summoning him. The reader will find some excellent remarks on this subject in the Medical Gazette, v. 719; xi. 740; and xvii. 816.

To determine whether or not a person is a fit subject for interdiction, it is necessary to bear in mind, that it is not enough to show there is delusion, as in the lighter cases of monomania; but we are bound to determine how far that delusion affects the judgment of a party so as to prevent him like other men from managing his affairs with provident care and propriety. In many instances, however, proof of delusion only is sought for; and if this be procured, it is somewhat hastily inferred, that the party is entirely incompetent to the management of his property. The most difficult cases are those involving questions of imbecility. In conducting the examination of an alleged lunatic, we should compare his mind as it is, with what it has been; and if it be a case of supposed imbecility, a proper regard must be had to age, society, education and general conduct. We should also consider whether the person has been treated by his friends and relations as a lunatic or imbecile prior to the issuing of the commission. A young person, whose education has been neglected, and who has never been entrusted with the care of money, cannot be expected to have much knowledge of the method of managing a large property. Questions are sometimes put on the moral responsibility of man and the attributes of God to one, who, perhaps, never heard of metaphysics. Arithmetical questions are asked which would embarrass many persons who are set down as sane and competent. In a case which occurred a few years since, one examiner asked the alleged imbecile, who said he had £1,200 in the bank and received £20 for interest,—How much that was per cent.? He said "he could not tell; he was no good hand at arithmetic." The counsel who appeared against the brieve or commission, afterwards put the same arithmetical question to one of the medical witnesses who had deposed to the imbecility of the party; and this witness confessed himself unable to answer it,—a practical illustration of the impropriety of pronouncing a person to be imbecile, merely because he is ignorant of what he has never been taught. (Case of David Yoolow, 1837.) If the capacity to manage affairs rested solely upon a knowledge of arithmetic, many now go free, who ought to be immediately placed under interdiction. This is rather a commercial test of insanity; but it will be found that it has been applied in a very improper way, to determine the capacity of young and ill-educated females. Unless the questions be confined to those subjects which the party has had either the opportunity or inclination to learn, a medical witness will always incur the risk of confounding mere ignorance with imbecility. Perhaps one of the best tests of mental capacity will be found in determining the degree to which, with ordinary opportunities, the individual has shown himself capable of being instructed. Too high a standard must not be assumed as a test for capacity. The mind of an alleged imbecile should not be compared with the most perfect mind; but with that of another person of average capacity, of the same age and station in society, and who has enjoyed like opportunities of instruction.

A medical witness must not allow himself to be embarrassed by medical or legal definitions of insanity. The malady may not have the form of strict lunacy or idiocy in a legal view; nor of mania, monomania, dementia, or idiocy in a strict medical view; but still it may be a case of *such mental disorder*, as to create an incapacity for managing affairs. This is the point to which a medical examiner has to direct his attention. Dr. Conolly has suggested one method of testing the state of mind, which it would be advisable to adopt, namely, to cause the individual to express his thoughts in writing. He would not here be led to suspect that he was being subjected to an examination for a hostile purpose. In many cases the evidence of a strong delusion existing in the mind, has been derived from a will, deed or letters written spontaneously by the lunatic or imbecile, when there was considerable difficulty in obtaining this proof by a verbal examination.

Many cases might be here cited to illustrate the medical evidence required and received on commissions of lunacy. One may be selected which excited much interest at the time of its occurrence,—I allude to that of Miss Bagster, which underwent inquiry in July 1832. It will serve to show upon what slight grounds, a verdict of "unsound mind" may be returned under commissions of lunacy, as they are at present conducted.

The subject of this inquiry was shown by the evidence to be a frivolous and weak-minded girl, whose education had been much neglected. She was heiress to a large fortune, and contracted a clandestine marriage unsuited to her condition. A commission was taken out by her friends for the purpose of annulling her marriage, by showing that she was not at the time competent to give rational consent. The general evidence showed that there had been great neglect in her education; and that she had been especially indulged, but it did not appear that she had ever been treated by her friends as of unsound mind, nor indeed that any question of her insanity had been raised until after the marriage. Seven medical witnesses, summoned to support the commission, deposed that she was of unsound mind; on the other side, no witnesses were called, as it was considered that the allegation of insanity was not made out. The commissioners, however, themselves called Dr. Morison and Dr. Haslam, who deposed that her incompetency to manage her affairs, arose not from unsoundness of mind, but from ignorance. She gave one strong proof of her sanity, namely, that she was aware of her deficiencies. It seems to have been allowed that she was capable of controlling herself, and concealing her defects; her answers to the questions put to her, were pertinent, and were for the most part correctly made, and she had capacity to receive instruction. She was ignorant of arithmetic, but this she had never been properly taught. She was young and inexperienced, and therefore unable to answer questions relative to the management of a household. The jury, by a majority of twenty to two, returned that she was of unsound mind, and had been so for two years, a time which covered the period of her marriage. (See for an excellent medico-legal report of this case Med. Gaz. x. 516, et seq.)

It is worthy of remark, that the only two medical witnesses, independent of both sides, who were summoned by the commissioners, gave a very strong opinion that Miss Bagster was *ignorant* and not of unsound mind; and that she might by instruction become competent to the management of her affairs. We should imagine that where the question arose, whether a young person was or was not to be deprived of all civil rights, there should at least be unanimity among the medical opinions, or, if this were denied, then more weight should be given to the negative than to the affirmative side of the question, providing, if, as in this case, the negative view was supported by men impartially selected, and of great experience and knowledge on the subject of insanity. It is not improbable, that besides ignorance, there may have been some degree of weakness of mind about this person, yet, taking the whole case, we must attribute the verdict of unsoundness, not so much to mental infirmity, as to incapacity from want of instruction, to manage a large fortune. But if every wealthy young lady whose education had been much neglected, had her sanity tested on the same points as Miss Bagster, it is certain that many who are now free agents, would be placed under interdiction. It has been attempted to justify the verdict by the statement that it saved her from the results of an imprudent marriage—the answer to which is, that commissions of *lunacy* are not intended to shield persons, whose minds are not really unsound, from the results of foolish and imprudent acts.

Lucid intervals.—By a lucid interval, we are to understand a temporary cessation of the insanity or a perfect restoration to reason. Thus, then, it differs entirely from a remission, in which there is a mere abatement of the symptoms. It has been said that a lucid interval is only a more perfect remission; and that although the lunatic may act rationally and talk coherently, yet his brain is in an excitable state; and he labours under a greater disposition to a fresh attack of insanity, than one whose mind has never been affected. Of this there can be no doubt; and the same reasoning would tend to show that insanity is never cured; for the predisposition to an attack is undoubtedly greater in a recovered lunatic, than in one who is and has always been perfectly sane. Even admitting the correctness of this reasoning, there is no doubt that lunatics do occasionally recover for a longer or shorter period, to such a degree as to render them perfectly conscious of, and legally responsible for their acts like other persons. The law intends no more than this by a lucid interval: it does not require proof that the cure is so complete, as that even the predisposition to the disease should be extirpated. Such proof, if it could even be procured, would be totally irrelevant. If a man acts rationally and talks coherently, we can have no better proof of a restoration to reason. If no delusion affecting his conduct remain in his mind, we need not concern ourselves about the degree of latent predisposition to a fresh attack, which may exist.

Lucid intervals sometimes appear suddenly in the insane:—the person feels as if awakened from a dream, and there is often a perfect consciousness of the absurdity of the delusion under which he was previously labouring. The duration of the interval is uncertain; it may last for a few minutes only, or may be protracted for days, weeks, months, and even years. In a medico-legal view, its alleged existence must always be looked upon with suspicion and doubt, when the interval is very short. These lucid intervals are most frequently seen in cases of mania and monomania,—they occasionally exist in dementia when this state is not chronic, but has succeeded a fit of intermittent or periodical mania. They are never met with in cases of idiocy and imbecility. It is occasionally a matter of great importance to be able to show whether or not there exists or has existed a lucid interval; since under these circumstances, the acts of an individual are deemed valid in law. The mind should be tested, as in determining whether the patient be labouring under insanity or not. He should be able to describe his feelings, and talk of the subject of his delusion without betraying any signs of unnecessary vehemence or excitement. It may happen that a person who is the subject of a commission of inquiry, is at the time of examination under a lucid interval, in which case there may be some difficulty in forming an opinion of the existence of insanity. This occurred in the case of Lady Seymour (July 1838);—when examined before the commission, her replies were so rational and collected, that no verdict could be given and the case was adjourned. When the inquiry was resumed, it was satisfactorily proved that she was insane, not merely by general and medical evidence, but from the terms of her will, which had been drawn up by herself.

It has been said that a person in a lucid interval is held by law to be responsible for his acts, whether these be of a civil or criminal nature. In regard to criminal offences committed during a lucid interval, it is the opinion of some medical jurists that no person should be convicted under such circumstances; because there is a probability that he might at the time have been under the influence of that cerebral irritation, which renders a man insane. (Prichard.) This remark applies more especially to those instances where the lucid interval is very short. Juries now very seldom convict, however rationally in appearance a crime may have been perpetrated, when it is clearly proved that the accused was really insane within a short period of the time of its perpetration.

CHAPTER LXV.

RESPONSIBILITY OF THE INSANE FOR CIVIL AND CRIMINAL ACTS.

Marriages.—Insanity is deemed in law to be a civil impediment to marriage, because it is considered that there cannot be that rational consent which is necessary to the validity of the contract. The marriage of a lunatic is therefore called a nullity, and is void ab initio. All that the law requires is, that there should be good proof of insanity at or about the time of the contract. If this be offered, and it be then alleged that the contract was entered into during a lucid interval, then the party who would benefit by the allegation, must prove it. The suitableness of the marriage, as well as the conduct of the party during or after its performance, will also be considered by the court. In the case of Turner v. Myers, a lunatic who had recovered from his lunacy, instituted a suit to set aside a marriage which he had contracted while in that state. The marriage was declared void. (Med. Gaz. viii. 481.)

Wills.—Questions involving the testamentary capacity of individuals are of very frequent occurrence, and medical evidence is commonly demanded. When property is bequeathed by a testator out of the usual order of succession, it may be alleged by the relatives that he was wholly incompetent to understand the nature of the deed, —either from actual insanity, the imbecility of age, or that natural failing of the mind which is so often observed to occur on the approach of death. Bodily disease or incapacity does not affect the validity of a will, unless the mind be directly or indirectly disturbed by it. Some time since a case occurred in France, in which a will was contested, on the ground that the testator, when he executed it, was labouring under hemiplegia. The opinion of Esquirol was demanded, and he said that hemiplegia might undoubtedly affect the brain, a fact clearly indicated by the sight, hearing, and other senses becoming weakened ; yet this, in his opinion, did not necessarily indicate an impairment of the understanding. A man's mind under these circumstances may not be so strong as in robust health, but still it may retain a disposing power. In the case of Harwood v. Baker, decided by the Privy Council in 1841, a will was pronounced to be invalid, owing to the general state of disease in which the testator was, at the time of making it. It appears that he was, labouring under erysipelas and fever ; and these diseases had produced a degree of drowsiness and stupor which rendered him incompetent to the act. In the case of Day, June 1838, epilepsy was alleged to have affected the mind ; and in the case of Blewitt, March 1833, paralysis was alleged as a ground of incompetency. In all cases of this kind, the law looks exclusively to the actual effect of the bodily disease upon the mind, and this is often a purely medical question.

A person is considered to be of a sane and disposing mind who knows the nature of the act which he is performing, and is fully aware of the consequences. From some decisions that have been made, it would appear that a state of mind for which a party might be placed under interdiction, would not render him incompetent to the making of a will. The validity of the will of a lunatic was once allowed, although made while he was actually confined in an asylum, because the act was rational, and it was such as the lunatic some years prior to the attack of insanity, announced his intention of making. (Coghlan's case.) The insanity of a party when not already found insane under a commission, must not in these cases rest upon presumption, but be established by positive proof. The commission of suicide is often hastily assumed to be evidence of insanity, but it would not be allowed as a proof of that state even where a testator destroyed himself shortly after the execution of the will. A case has been decided where the testator had committed suicide three days after having given instructions for his will; but the act was not allowed to be a proof of insanity, and the will was pronounced to be valid. A similar case has been thus decided in the French courts. Besides, as we shall see hereafter, suicide is not deemed in law to be a proof of insanity.

The validity of deeds executed by persons afflicted with monomania often becomes a subject of dispute. The practice of the law here indicates that the mere existence of a delusion in the mind of the person does not necessarily vitiate the deed, unless the delusion form the groundwork of it, or unless the most decisive evidence be given that at the time of executing the deed, the testator's mind was influenced by it. Strong evidence is often derivable from the act itself, more especially where the testator has drawn it up of his own accord. In the case of Barton, July 1840, the Ecclesiastical Court was chiefly guided in its decision by the nature of the instrument. The testator, it appeared, laboured under the extraordinary delusion, that he could dispose of his own property to himself, and make himself his own legatee and executor! This he had accordingly done. The instrument was pronounced to be invalid. But a will may be manifestly unjust to the surviving relatives of a testator, and it may display some of the extraordinary opinions of the individual, yet it will not necessarily be void, unless the testamentary dispositions clearly indicate that they have been formed under a delusion. Some injustice may possibly be done by the rigorous adoption of this principle, since delusion may certainly enter into a man's act, whether civil or criminal, without our being always able to discover it; but after all, it is perhaps the most equitable way of construing the last wishes of the dead.

The evidence in these cases sometimes amounts to proof of eccentricity only on the part of the testator, or in the deed itself; but a clear distinction must be here drawn. The will of an eccentric man is such as might always have been expected from him,—the will of one labouring under insanity (delusion) is different from that which he would have made in an unaffected state;—the instrument is wholly different from what it would once have been.

In the case of a Mr. Stott, a medical electrician, whose will was disputed by his daughter on the ground of insanity, it was proved that the testator fancied he could deliver pregnant women by means of electricity, and he actually proposed to the wife of a baker living in the neighbourhood, to bring about her accouchement by an electrical machine! The will was pronounced invalid, not so much on the ground of this extreme absurdity, as of the violent and unnatural treatment to which he had subjected his daughter. It appeared that he had taken, as we now and then find in monomaniacs, a most unaccountable and causeless dislike to this girl from her earliest infancy.

Wills are sometimes contested more on the ground of eccentricity than of insane delusion; but if eccentricity only be proved, a court will not interfere. In the case of Morgan v. Boys, 1838, it was proved that the testator in his will had left a large fortune to his housekeeper. The will was disputed on the ground that it bore intrinsic evidence of the deceased not having been in a sane state of mind at the time of making it. After having bequeathed his property to a stranger, the testator directed that his executors should "cause some parts of his bowels to be converted into fiddle-strings,—that others should be sublimed into smelling salts, and that the remainder of his body should be vitrified into lenses for optical purposes!" He further added in a letter attached to his will—"The world may think this to be done in a spirit of singularity or whim, but I have a mortal aversion to funeral pomp, and I wish my body to be converted to purposes useful to mankind." Sir H. Jenner, in giving judgment, held that insanity was not proved:—the facts merely amounted to eccentricity, and on this ground he pronounced for the validity of the will. It was proved that the deceased had conducted his affairs with great shrewdness and ability, that he not only did not labour under imbecility of mind, but that he had been always treated during life as a person of indisputable capacity by those with whom he had to deal. The best rule to guide the court, the judge remarked, was the conduct of parties towards the deceased; and the acts of his relatives evinced no distrust of his sanity or capacity while he was living. The deceased had always been noted for his eccentric habits, and he had actually consulted a physician upon the possibility of his body being devoted to chemical experiments after death.

Wills made in incipient dementia arising from extreme age (senile imbecility) are sometimes disputed, either on the ground of mental deficiency, or from the testator, owing to weakness of mind, having been subjected to control and influence on the part of interested persons. If a medical man be present when the will is made, he may easily satisfy himself of the state of mind of the testator, by requiring him to repeat from memory the way in which he has disposed of the bulk of his property. Medical men have sometimes placed themselves in a serious position by becoming witnesses to wills under these circumstances, without first assuring themselves of the mental condition of the testator. It will always be a good ground of justification, if, at the request of the witness, the testator repeated substantially the leading provisions of his will from memory. If a dying person cannot do this without prompting or suggestion, there is reason to believe that he has not a sane and disposing mind. It has been observed on some occasions where the mind has been weakened by disease or infirmity from age, that it has suddenly cleared up before death, and the individual has unexpectedly acquired a disposing capacity.

Wills made by persons whose capacity during life had never been doubted, while lying at the point of death, or as it is termed *in extremis,* are regarded with suspicion; and may be set aside according to the medical circumstances proved. Many diseases, especially those which affect the brain, or nervous system directly or indirectly, are likely to produce a dulness or confusion of intellect, under which a disposing power is lost. Delirium sometimes precedes death, in which case a will executed by the dying person, would be at once pronounced invalid.

Criminal responsibility.—The rule of law with regard to this subject is, that no man is responsible like a sane person, for any act committed by him while in a state of insanity. This is a subject of considerable importance in a medico-legal view; for should a plea of insanity be improperly admitted in any criminal case, then punishment is made to fall unequally on offenders; and if, on the other hand, it be improperly rejected, punishment is administered with undue severity. A plea of insanity may be raised for the smallest offence up to the highest crime—murder; but it is rarely raised in respect to smaller offences, because the close confinement to which the offender if found insane would necessarily be subjected, would often be a heavier punishment, than that which the law actually prescribes for the offence which he may have committed. In a case of felonious assault lately tried, it was urged by the counsel in defence that the prisoner was insane, but the evidence on this point was not by any means conclusive,—when it was intimated by the court that if this plea were admitted, the party would probably undergo a much longer imprisonment, than if on conviction he received the legal punishment for the offence. (See the case of the Queen v. Reynolds, Bodmin Aut. Ass. 1843.) The judge is reported to have said that there was no proof of insanity. If he was pronounced insane, he might be imprisoned for life, and therefore he did not think that finding would benefit the prisoner. A verdict of guilty was returned, and the man was sentenced to eighteen months' imprisonment. This case shows at least that a defence of this kind may be sometimes indiscreetly put forward. Murder, incendiarism and theft, are the crimes for which this plea has been raised;—and it has been more especially confined in this country to those cases where persons have been charged with murder or attempts at murder. It is customary to say that those who commit these crimes while in a state of insanity, are irresponsible. By this we are not to understand that they are allowed to go free. On the contrary, they are subject to close confinement, commonly perpetual, as it assuredly ought to be in the case of murder; but depending on their recovery in respect to crimes of less magnitude. A power is vested in the executive to discharge recovered lunatics, according to circumstances. This subject will be, perhaps, best considered under the following heads.

I. Homicidal monomania.—Most medical jurists admit that individuals who may not appear to labour under any intellectual aberration, are liable to be seized with a sudden destructive impulse, under which they will destroy those to whom they are most fondly attached, or any person who may happen at the time to be involved in the subject of their delusion. Sometimes the impulse is long felt, but concealed and restrained: there may be merely signs of depression and melancholy about the individual, nothing, however, to lead to a suspicion of the fearful contention which may be going on within his mind. Occasionally the murder may be perpetrated with great deliberation, and under all the marks of sanity. These cases are rendered difficult by the fact that there may be no clear proof of the existence, past or present, of any disorder of the mind, so that it would appear the chief evidence which could be adduced of the existence of insanity would be in the act itself:—of the existence of the malady before and after the perpetration of the crime, there may be either no evidence whatever, or it may be so slight as scarcely to amount to proof. Some have looked upon such cases as instances of insanity of the moral feelings only,—"moral insanity," but an unrestricted admission of this doctrine would go far to do away with all punishment for crime, for it would then be impossible to draw a line between insanity and moral depravity, and the law will not at present excuse an act committed through moral depravity. The works of Marc, Esquirol and Prichard abound in illustrations of this form of monomania; but I prefer selecting one which came to trial in England a few years since, as it will serve to illustrate the difficulties which these cases present. It was tried on the Midland Circuit, July, 1837.

A man named Greensmith was charged with the murder of four of his young children. The facts here to be related were partly brought out in evidence, and partly by his own confession. He was a man of industrious habits and an affectionate father: but having fallen into distressed circumstances, he destroyed his children by strangling them, in order, as he said, that they might not be turned into the streets. The idea only came to him on the night of his perpetrating the crime After he had strangled two of his children in bed, he went down stairs, where he remained some time; but thinking that he might as well suffer for all as for two, he returned to the bed-room, and destroyed the two whom he had left alive. He shook hands with them before he strangled them. He left the house and went to a neighbour's, but said nothing of the murder, until he was apprehended the next day and taken before the coroner, when he made a full confession. Not one of the witnesses had ever observed the slightest indication of insanity about him. He made no defence, but several humane medical practitioners came forward to depose that he was insane. The surgeon of the gaol said that the man was feverish, complained of headache, and had been subject to disturbed sleep and sudden starts since the death of his wife, a short time before. He spoke of the crime he had committed without the slightest excitement, and the witness said he had heard enough of the evidence to satisfy him that the prisoner could not have committed such a crime as this, and be in a sane state of mind. Dr. Blake, physician to the Nottingham Lunatic Asylum, said he was satisfied that the prisoner laboured under a delusion of mind. The prisoner's grandmother and sister had been under his care, the latter for entertaining a similar delusion, namely, that of destroying herself and her children. The judge declined receiving this evidence; and under his direction the prisoner was found guilty, and sentence of death was passed upon him. By the active interference of Dr. Blake and others, he was respited on the ground of insanity. (See Med. Chir. Rev. xxviii. 84.)

Other examples of homicidal monomania might be found in the cases of Nicholas Steinberg, who cut the throats of his wife and four children, and then destroyed himself, in Sept. 1834,—of Lucas, who destroyed his three children in March, 1842; and of a named Giles, who cut the throats of two of his infant children at Hoxton, in January, 1843. In all of these cases the unexpected act of murder was accompanied by suicide. They may be regarded as fearful examples of homicidal mania, in which there were no previous symptoms, indicative of insanity, or any irregularity of conduct on the part of the homicides, to justify the least interference with their civil liberty. One remarkable feature in these unrecognizable cases is, that the murderous act is commonly directed against those who are most closely connected with the homicides in blood, and to whom they are attached by the tenderest ties

It is impossible that such crimes as these can be regarded as the acts of sane individuals, and even those who are the most sceptical on the subject of such a form of insanity as homicidal monomania, are compelled to admit that these dreadful, motiveless murders are the acts of insane, and therefore irresponsible agents. It may be a dangerous doctrine to adduce the crime as evidence of insanity, but these cases clearly prove that there are some instances in which this is the only procurable evidence. Had not the homicides destroyed themselves, it is almost morally certain that they would have been acquitted on the ground of insanity. In the case of Staninought this actually took place—this man who had attempted suicide recovered, was tried, and acquitted on the ground of insanity, but afterwards destroyed himself.

Admitting then the existence of this state of homicidal monomania, it will become a question, how, when pleaded for one, charged with murder, it is to be distinguished from a case where the crime has been perpetrated by a really sane person. Tests, both medical and legal, have been proposed. The legal test has been lately explicitly given by the whole of the judges in conference, in answer to queries put by the House of Lords in reference to the case of M'Naughten, lately tried and acquitted on the ground of insanity. (June 19th, 1843.)

> The jury ought in all cases to be told that every man should be considered of sane mind until the contrary were clearly proved in evidence. That before a plea of insanity should be allowed, undoubted evidence ought to be adduced that the accused was of diseased mind, and that at the time he committed the act, he was *not conscious of right or wrong.* Every person was supposed to know what the law was, and therefore nothing could justify a wrong act, except it was clearly proved that the party did not know right from wrong. If that was not satisfactorily proved, the accused was liable to punishment.
>
> If the *delusion* under which a person laboured were only *partial,* the party accused was equally liable with a person of sane mind.

It would appear from this that the law, in order to render a man responsible for a crime, looks for a consciousness of right and wrong, and a knowledge of the consequences of the act. Thus, as it was laid down by the judge in Greensmith's case, the complete possession of reason is not essential to constitute the legal responsibility of an offender; and it is also to be inferred from the results of several cases, that a man may be civilly incompetent, but sufficiently sane to be made criminally responsible. The proofs required in the two cases are essentially distinct.

It has been very properly objected to this legal test, that it is insufficient for the purpose intended: it cannot enable us to distinguish the insane homicide from the sane criminal. Many insane persons have committed acts which they knew to be wrong, and of the criminality of which they were at the time perfectly conscious. They have been known to murder others, in order to receive the punishment of death at the hands of the law; and, therefore, they must have known that the act which they were perpetrating was an offence against the law of man. In short, the criminal nature of the act has often been the sole motive for its perpetration!

In Greensmith's case (antè, p. 644) there was no doubt that the man knew he was doing wrong and what was contrary to law; for after having murdered two of his children, he returned and murdered the others, considering that he might as well suffer for all as for two! The case of Hadfield, who was tried for shooting at George III. and acquitted on the ground of insanity, furnishes another striking example of the existence of insane delusion, coupled with a full knowledge of the consequences of the act which he was about to commit. He knew that in firing at the king he was doing what was contrary to law; and that the punishment of death was attached to the crime of assassination; but the motive for the crime was that he might be put to death by others,—he would not take his own life. Again, Martin, the incendiary, admitted that he knew he was doing wrong according to the law of man, when he set fire to York Cathedral: he was conscious that the act was illegal, but he said he had the command of God to do it. Thus then we find a full consciousness of the illegality or wrongfulness of an act may exist in a man's mind, and yet he may be fairly acquitted on the ground of insanity. It seems then extraordinary that "a consciousness of right or wrong" at the time of the perpetration of a crime, should be still upheld as the only legal test to distinguish a sane from an insane perpetrator. The rule cannot be carried out without inflicting the punishment of death on many really insane persons :—and it is perhaps sufficient to say, that circumstances frequently occur which render its relaxation imperatively necessary. (See post, Puerperal Mania.)

It will now be proper to examine the tests which have been proposed by medical jurists for detecting these cases of homicidal mania.

1. These acts of homicide have generally been preceded by other striking peculiarities of conduct in the individual, often by a total change of character. 2. They have in many instances previously attempted suicide: they have expressed a wish to die or to be executed as criminals.

These supposed criteria have been repeatedly and very properly rejected, when tendered as evidence of insanity in courts of law. They are of too vague a nature, and apply as much to cases of moral depravity as of actual insanity : in short, if these were admitted as *proofs*, they would serve as a convenient shelter from punishment for most criminals.

3. These acts are without motive : they are in opposition to all human motives. A man murders his wife and children known to have been tenderly attached to them : a mother destroys her infant.

It is hereby assumed or implied that sane men never commit a crime without an apparent motive ; and that an insane person never has a motive, or one of a delusive nature only, in the perpetration of a criminal act. If these positions were true, it would be very easy to distinguish a sane from an insane criminal ; but the rule wholly fails in practice. In the first place, the *non-discovery* is here taken as a proof of the *non-existence* of a motive: while it is undoubted that motives may exist for many atrocious criminal acts without our being able to discover them, a fact proved by the numerous recorded confessions of criminals before execution, in cases where, until these confessions had been made, no motive for the perpetration of the crimes had appeared to the acutest minds. It is clear, that if before inquiring into the perpetration of a murder, the law were to search for motives, and rest the responsibility of an accused party upon the accidental discovery of what ought to be deemed a *reasonable* motive (!) many most atrocious criminals would necessarily go unpunished, and some lunatics be executed. Besides, if one accused person is to derive benefit from an apparent absence of motive, there is no reason why the same benefit should not be extended to all who are charged with crimes. In the case of Courvoisier, who was convicted of the murder of Lord William Russell in June, 1840, it was the reliance upon this fallacious criterion, before the secret proofs of guilt accidentally came out, that led many to believe he could not have committed the crime ; and the "absence of motive" was urged by his counsel as the strongest proof of the man's innocence. It was ingeniously contended " that the most trifling action of human life had its spring from some motive or other." This is undoubtedly true, but it is not always in the power of a man untainted with crime, to detect and unravel the motives which influence criminals in the perpetration of murder. No reasonable motive was ever discovered for the atrocious murders and mutilations perpetrated by Greenacre and Good, yet these persons were very properly made responsible for their crimes. On the trial of Francis for shooting at the Queen, the main ground of defence was, that the prisoner had no motive for the act, and therefore was irresponsible, but he was convicted. It is difficult to comprehend under what circumstances any motive for such an act as this could exist; and therefore the admission of such a defence would have been like laying down the rule, that the evidence of the perpetration of so heinous a crime should in all cases be taken as proof of irresponsibility!

Crimes have been sometimes committed without any apparent motive, by sane individuals, who were at the time perfectly aware of the criminality of their conduct. No mark of insanity or delusion could be discovered about them, and they had nothing to say in their defence. They have been very properly held responsible. On the other hand, lunatics confined in a lunatic asylum have been known to be influenced by motives in the perpetration of crimes. Thus they have often murdered their keepers out of revenge for ill-treatment which they had experienced at their hands. See the case of the Queen v. Farmer, York Spring Assizes, 1837. This man was acquitted as insane, while the clear motive for the homicide was revenge and ill-feeling. On the whole, the conclusion with respect to this assumed criterion is, that an absence of motive may, where there are other strong evidences of insanity, favour the view of irresponsibility for crime; but the non-discovery of a motive for a criminal act cannot of itself be taken as any proof of the existence of homicidal monomania in the perpetrator.

4 The subsequent conduct of the individual:—he seeks no escape, delivers himself up to justice, and acknowledges the crime laid to his charge.

This is commonly characteristic of homicidal mania; for by the sane criminal every attempt is made to conceal all traces of the crime, and he denies it to the last. A case has recently occurred, however, which may put this criterion to the test,—I allude to that of Richard Dadd, who murdered his father at Cobham, in September, 1843, under circumstances apparently indicative of homicidal mania; but that he fled after the perpetration of the crime, and has not since been heard of. Besides, it must be remembered that sane persons who destroy the lives of others through revenge or anger, often perpetrate murder openly, and do not attempt to deny or conceal the crime; for they know that denial or attempt at concealment would be hopeless. Again, a morbid love of notoriety will often induce sane criminals to attempt assassination under circumstances, where the attempt must necessarily be witnessed by hundreds, and there can be no possibility of escape. The recent attacks made on the life of the Queen, are sufficient to bear out this statement.

5. The sane murderer has generally accomplices in vice or crime; the homicidal monomaniac has not.

This is a weak criterion; for some of the most atrocious murders, committed in modern times, as those perpetrated by Greenacre, Good, Courvoisier, and others, were the acts of solitary individuals, who had neither accomplices nor any assignable inducements leading to the commission of the crimes; yet, notwithstanding the absence of motives and the want of accomplices, it is impossible to doubt that they were very properly held responsible.

The case of Francis, who was tried and convicted for shooting at the Queen, will show that no value is placed upon these criteria by the law. Here was evidence of the act being without motive,—of its having been perpetrated openly,—of the individual seeking no escape by flight, but delivering himself up to justice,—and of there being no accomplices in vice or crime;—but still he was very properly held responsible for the act. The criteria above given can hardly be described as medical;—they are circumstances upon which a non-professional man may form as safe a judgment as one who has made insanity a special study.

The presence of delusion has been said to characterize an act of homicidal monomania, while premeditation, precaution, and concealment have been considered the essential features of the act of a sane criminal. With respect to delusion, it has been decided that the mere proof of the existence of this does not excuse an act: if the delusion be *partial*, the party accused is still responsible;—and if the crime were committed for an imaginary injury he would be equally responsible. (See antè, p. 646.) Much stress was formerly laid upon the delusion being connected with the act in cases of insanity; but it must be remembered that, except by the confessions of insane persons during convalescence, it is not commonly easy for a sane mind to connect their most simple acts with the delusions under which they labour. Every act of homicide perpetrated by a really insane person is doubtless connected with some delusion with which he is affected; but it by no means follows, that one who is sane should always be able to make out that connection; and it would be therefore unjust to rest the irresponsibility of the accused upon an accidental discovery of this kind. Premeditation and precaution are met with in crimes committed both by sane and insane criminals, although these, with subsequent concealment, are certainly strong characteristics of sanity. It is also a question, whether, when they are proved to have existed in any criminal act, there might not have been such a power of self-control in the individual as to justify the application of punishment. Are such individuals more beyond the influence of example than one-half of the criminals who are punished?

The foregoing considerations lead to the inference, that there are no certain legal or medical rules, whereby homicidal mania may be detected. Each case must be determined by the circumstances attending it: and the true test for irresponsibility appears to be, if it could be practically applied, whether the individual, at the time of the commission of the crime, had or had not a sufficient power of control to govern his actions. A test somewhat similar to this, is constantly applied to distinguish murder from manslaughter; and it is quite certain, that sanity and homicidal mania, are not more nicely blended, than are occasionally the shades of guilt whereby murder passes into manslaughter. The manner in which a crime is committed, will often allow a fair inference to be drawn, as to how far a power of self-control existed. A man in a violent fit of mania rushes with a drawn sword into an open street, and stabs the first person whom he meets;—another, worn out by poverty and destitution, murders his wife and children to prevent them starving, and then probably attempts to murder himself,—these are cases in which there is fair ground to entertain a plea of irresponsibility; but when we find a man lurking for many days together in a particular locality, having about him a loaded weapon,—watching a particular individual who frequents that locality,—a man who does not face the individual and shoot him, but who coolly waits until he has an opportunity of discharging the weapon unobserved by his victim or others,—the circumstances appear to show such a perfect adaptation of means to ends, that one is quite at a loss to understand, why a plea of irresponsibility should be admitted except upon the fallacious ground, that no motive could be discovered for the act,—a ground, however, which was not allowed to prevail in the case of Francis, and the perpetrators of other atrocious crimes.

The facts here referred to apply to the case of M'Naughten, who was tried for the murder of Mr. Drummond, (Jan. 7, 1843,) and acquitted on the ground of insanity. There is hardly a doubt that had the deceased given any personal offence to this individual, before the perpetration of the act, he would have been convicted: if the deceased, from feeling annoyed at his following him, had struck him or pushed him away before the pistol was fired, it is most probable that the plea of insanity would not have been received. In the acquittal of this man, it is evident that considerable importance was attached to the non-discovery of a motive; for had any kind of motive been apparent, it is pretty certain that an alleged homicidal climax, occurring at the particular moment when the deceased's back was turned, and after several days' watching on the part of the assailant, would not have been admitted as a sufficient exculpatory plea. If we except the case of Oxford, tried for shooting at the Queen, there is perhaps no case on record in English jurisprudence where the facts in support of the plea of insanity were so slight; and when the cases of Bellingham, Lees and Cooper, are considered, the two latter tried and executed within the last few years, it must be evident that there is both uncertainty and injustice in the operation of our criminal law. Either some individuals are most improperly acquitted on the plea of insanity, or others are most unjustly executed. If the punishment of death were abolished there is no doubt that less would be heard of this plea, but in the mean time, it is unfortunate that there is no other way of evading capital punishment, than by making it appear that the criminal was insane. (See Prichard, 399.) It is on this point that medical winesses seem to me to lose sight of their true position. In giving an opinion of the mental condition of an offender, it is no part of their province to model that opinion according to the punishment which may follow if the plea be rejected, but according to the facts of the case. The legislature only is responsible for the punishment adjudged to crimes. One great evil is that under this system, the law operates most unequally. One case becomes a subject of prominent public interest, and every exertion is made to construe the most trivial points of character into proofs of insanity: an acquittal follows. Another case tried at the assizes, may excite no interest,—it is left to itself,—the accused is convicted, and either executed or otherwise punished; although the evidence of insanity, had it been as carefully sought for and brought out, would have been as strong in this, as in the former instance. That this kind of defence is being carried too far, will be apparent from the observation of Mr. Baron Gurney, in the case of the King v. Reynolds, where the judge said that "the defence of insanity had lately grown to a fearful height, and the security of the public required that it should be watched." So also Mr, Justice Coltman, in the case of the Queen v. Weyman, remarked, that "the defence of insanity was one which was to be watched with considerable strictness, because it was not any slight deviation from the conduct which a rational man would pursue under a given state of circumstances, which would support such a line of defence." When the punishment attached to an offence is not capital, it would appear that much stronger evidence is required to establish a plea of insanity than under other circumstances. This will be seen by reference to the case of the Queen v. Grove, Stafford Lent Assizes 1843. The evidence of insanity was considerably stronger than that adduced in the case of M'Naughten, yet the prisoner was convicted. These two cases occurring so recently, the one after the other, display the uncertainty attendant upon a plea of this kind. So again it would be difficult to reconcile upon medical grounds, the acquittal of Francis with the conviction of Oxford, both of them tried for the same crime, (shooting at the Queen,) committed under similar circumstances. In the case of the Queen v. Stolzer, (Central Criminal Court, Oct. 1843,) where the charge was one of murder by stabbing, the plea of insanity was rejected, although no motive appeared, and there were some indications of insanity. In another case, (the Queen v. Rowe,) tried at the same time, the prisoner, an old man, deliberately fired a loaded pistol at his master, because he had discharged him from his service and would not take him back. There was no mark of insanity either in the act or in his previous conduct, but he was acquitted as insane, on the lenient presumption, that he might be labouring under the imbecility of age. These decisions clearly show, that every case will be determined, not by medical rules or opinions, but by the peculiar circumstances which accompany it.

Some doubt has existed whether a medical witness, on a trial in which the plea of insanity is raised, could be asked his opinion respecting the state of the prisoner's mind at the time of the commission of the alleged crime,—whether the accused was conscious at the time of doing the act, that he was acting contrary to law, or whether he was then labouring under any and what delusion. It has been now decided by fourteen judges out of fifteen, that facts tending to lead to a strong suspicion of insanity must be proved and admitted, before the opinions of medical witnesses can be received on these points.

It is proper that a medical witness should remember, in examining an accused party, who is alleged to have committed a crime while labouring under insanity, that the plea may be good, and yet the individual be sane, when examined. This was observed in the case of a lunatic, who killed his mother, in February 1843. There was no doubt that he was insane at the time of the act; but two days afterwards, he was found to be of perfectly sound mind. This sudden restoration to reason, is sometimes met with in cases of homicidal mania.

CHAPTER LXVI.

CRIMINAL RESPONSIBILITY.

Suicidal Mania.—In monomania, especially in that form which is called melancholia, or lypemania, there is often a strong propensity to the commission of suicide. This may proceed from sudden impulse or from delusive reasoning. Suicidal mania is susceptible of being spread by imitation, more especially where the mode of self-destruction adopted is accompanied by circumstances of a horrible kind, or exciting great notoriety. The sight of a weapon or a particular spot where a previous suicide has been committed, will often induce a person, who may have been hitherto unsuspected of any such disposition, at once to destroy himself. In some instances an individual fancies that he is oppressed and persecuted, that his prospects in life are ruined, when on the contrary, his affairs are known to be flourishing. He destroys himself under this delusion. In cases of this description, whether arising from a momentary insane impulse, or from delusive reasoning, there cannot be a doubt that the act is one of insanity. It is very different, however, where a real motive is obviously present,—as where an individual destroys himself to avoid disgrace, or impending ruin, because here the results are clearly foreseen, and the suicide calculates that the loss of life would be a smaller evil than the loss of honour and fortune. It may be urged that a motive of this kind will appear insufficient to the minds of most men ;—but what known motive is there sufficient to account for parricide, infanticide, or any other crime of the like horrible nature? It appears to me we must allow either that all crime is the offspring of insanity, or that suicide is occasionally the deliberate act of a sane person. To say, that suicide is always per se evidence of insanity, is to say substantially, that there is no criminality in self-murder; for it is impossible to regard that act as a crime, which is committed under a really insane delusion.

The law of England, however, very properly treats suicide as felony; those who have attempted and failed in its perpetration, are treated as sane and responsible agents, unless there should be very clear evidence of insanity, and it is pretty certain, that the evidence so required must be much stronger, than that sometimes admitted in cases of homicide. Thus had Oxford and M'Naughten attempted to destroy themselves and failed, and afterwards been tried for the misdemeanour, it is almost certain that they would have been convicted. The facts adduced at their trials, would most probably, under these circumstances, have been deemed insufficient to establish their insanity and consequent irresponsibility for the attempts on their own lives. Some singular medico-legal cases have occurred lately involving the question—how far the act of attempting suicide is indicative of insanity.

In the case of the Queen v. Rumball, (Cent. Crim. Court, May 1843,) the prisoner was charged with attempting to drown her child. It appeared in evidence that she fastened her child to her dress and threw herself into a canal with the intention of destroying herself. She was rescued, and she was tried and convicted of the felony of attempting to murder her child by drowning. Had she not been rescued, it is very probable that the verdict of a jury would have been, as it so frequently is on these occasions—"temporary insanity." In the case of the Queen v. Gathercole, 1839, a man was charged with the manslaughter of the deceased, under the following circumstances. The prisoner threw himself into a canal for the purpose of drowning himself: the deceased, who was passing, jumped in and rescued him; but by some accident he was himself drowned in the humane attempt. The defence was, that the prisoner was at the time insane, and therefore irresponsible; but this was negatived, and the prisoner was convicted. So if a man intending to shoot himself fails, and by accident shoots a bystander, he will be held responsible, unless there be very clear proof of insanity:—the act—the attempt itself, taken alone will not be admitted as evidence.

It is well known that a policy of life-assurance is forfeited by the act of suicide according to the rules of some offices; but supposing it to have been really an act of insanity, would it be legally forfeited? In an equitable view the policy should not be forfeited under these circumstances, any more than if the party had died accidentally by his own hands. The condition truly implies that the party puts himself to death deliberately, and not unconsciously while labouring under a fit of delirium or insanity. This question has been before the English courts of law for the last two years, in the case of Borradaile v. Hunter, and has been only recently decided. (May 1843.)

This was an action brought to recover the amount of a policy of insurance effected on the life of a clergyman who threw himself into the Thames from Vauxhall Bridge and was drowned. At the trial of the case, the judge told the jury that if the deceased threw himself into the river, knowing that he should destroy himself and intending so to do, the policy would be void:—they had further to consider, whether the deceased was capable of distinguishing between right and wrong at the time, or in other words, whether he had a sufficient knowledge of the consequences of the act to make him a felo-de-se. The jury found that the deceased threw himself into the water intending to destroy himself; and that previous to that time, there was no evidence of insanity. They were then directed to take the act itself with the previous conduct of the deceased into consideration, and say whether they thought, at the time, he was capable of knowing right from wrong. They then found that he threw himself from the bridge with the intention of destroying himself, but that he was not then capable of judging between right and wrong.

The jury were here evidently perplexed with the strict meaning of the words right and wrong:—the first part of the verdict made the case one of felo-de-se, the last part made it one of insanity.

The verdict was entered for the defendants, i. e. that the deceased was a felo-de-se, and that the policy was void. The case was subsequently argued before the judges: it was contended for the plaintiff, that according to the terms of the policy there must have been an intention by the party assured. to die by his own hands; and that an insane person had no controllable intention. The judges differed:—three considered that there was no ground for saying that the deceased was affected by an uncontrollable impulse,—on the contrary, the jury had found that he threw himself into the river, knowing that he should destroy himself and intending to do so In their opinion, the act was one of felo-de-se, and the policy was void. One judge considered, that the verdict should be for the plaintiff, thereby leading to the inference, that the act of suicide was in this case the result of insanity, and not of a felonious killing.

From these cases one point is clear,—the act of suicide is not treated by the law as a necessary proof of insanity; and therefore the ingenious arguments which have been held on this subject, have but little interest for the medical jurist in a practical view. It has been elsewhere stated, that acts of suicide have been mistaken for homicide, merely because the deceased had expressed no intention of destroying himself and had manifested no disposition to the act by his previous conduct. This, however, is a very fallacious view of the subject; since suicide from sudden impulse is by no means unfrequent; and even where the act bears about it marks of deliberation, it is not to be expected that the individual should announce his intention; for this would be a sure way of defeating his object. Perhaps one of the most remarkable instances of suicide from sudden impulse, is the following, which is related by Sir Charles Bell:

Many years since one of the surgeons of the Middlesex Hospital was in the habit of going every morning to be shaved by a barber in the neighbourhood, who was known as a steady, industrious man. One morning some conversation arose about an attempt at suicide which had recently occurred; and the surgeon remarked that the man had not cut his throat in the right place. The barber then casually inquired where the cut should have been made; and the surgeon pointed to the situation of the carotid artery. A few minutes afterwards, the surgeon was alarmed by hearing a noise at the back of the shop, and on rushing to the spot found that the barber had cut his own throat with the razor with which he had been shaving him. The man speedily died!

PUERPERAL MANIA.—A homicidal propensity towards their offspring, sometimes manifests itself in women, soon after parturition. It seldom appears before the third day, often not for a fortnight; and in some instances not until several weeks after delivery. According to Esquirol, it is generally attended by a suppression of the lochia and milk. Its symptoms do not differ from those of mania generally. It may last a few hours or for some days or weeks. The murder of the child is generally the result of delirium: or of an uncontrollable impulse, with a full knowledge of the wickedness and illegality of the act,—so that the legal test of responsibility of a knowledge of right and wrong, cannot be applied to such cases. Mothers have been known before the perpetration of the murder, to request their attendants to remove the child. Such cases are commonly known from deliberate infanticide, by there being no attempt at concealment nor any denial of the crime on detection. Several trials involving a question of puerperal mania, have been decided within the last few years. Dr. Ashwell has remarked, that undue lactation may give rise to an attack of mania, under which the murder of the offspring may be also perpetrated. (G. H. Rep. x. 69.)

PYROMANIA.—This is described as a variety of monomania in which there is a morbid disposition of mind, leading to acts of incendiarism, without any motive. It is said to proceed from sudden impulse or from delusive reasoning, but most commonly the latter. It has been chiefly remarked in females about the age of puberty, and is supposed to be connected with disordered menstruation. An extraordinary instance of pyromania is quoted in the case of Jonathan Martin, who fancied himself to be deputed from God to burn down the cathedral of York in order to do away with the heresies which he supposed to exist in the church. It is said to be not uncommon in young persons about the age of puberty. Admitting that a morbid impulse of this kind may exist, it should be very cautiously received as an exculpatory plea; since it might be easily converted into a means for withdrawing real criminals from all legal control. The plea has been already admitted in the English law. (See case Med. Gaz. xii. 80.)

KLEPTOMANIA.—This term has been applied by Marc, to that form of monomania which manifests itself by a propensity to acts of theft. It has been remarked by him, that this propensity has often shown itself in females far advanced in pregnancy, the motive being the mere wish of possession. Pregnancy, according to him, should be a good exculpatory plea, where a well-educated woman of strict moral conduct steals some unimportant article of no value compared with her worldly means and position in society. There are many instances on record, where well-educated persons moving in a respectable sphere of society, have been guilty of petty acts of theft. The articles taken have been valueless compared with their means. Instances of this kind have been brought before our police-courts: and this motiveless impulse to theft has been occasionally pleaded; but in most of these, the following facts have been established by evidence: 1. A perfect consciousness of the act. 2. The article, although of trifling value, has still been of some use to the person,—thus these females have stolen articles only adapted to female use. 3. There have been art and precaution in endeavouring to conceal the theft; and 4, a denial of the act when detected, or some evasive excuse. When circumstances of this kind are proved, either the parties should be made responsible, or theft should be openly tolerated. The evidence of a disordered state of the mind should not be here allowed to depend on the nature of the act, or every morally depraved person might bring forward a plea of insanity for any crime or offence.

DIPSOMANIA, DRUNKENNESS.—This state, which is called in law frenzy, or "*dementia affectata,*" is regarded as a temporary form of insanity. Jurists and legislators have differed widely respecting the degree to which drunkards should be made responsible for their acts.

When the mind of a man is completely weakened by *habitual* drunkenness, then the law infers irresponsibility, unless it plainly appear, that the individual was at the time of the act, whether of a civil or of a criminal nature, endowed with full consciousness and reason to know its good or evil tendency.

Any deed or agreement made by a party while drunk, is not invalidated by our law, except in the case where the intoxication has proceeded so far as to deprive him of all consciousness of what he is doing; and a court will not interfere, unless the drunkenness were the result of collusion by others for the purposes of fraud. Thus the law appears to make two states in drunkenness, one where it has proceeded to but a slight extent, and where it is considered that there is still a power of rational consent:—another where it has proceeded so far, that the individual has no consciousness of the transaction, and therefore can give no rational consent. The proof of the existence of this last state would vitiate all the civil acts of a party. A confession made by a man while in a state of drunkenness, is legally admissible as evidence against him and others, provided it be corroborated by circumstances.

In a case recently tried, the prisoner confessed while drunk that he had committed a robbery and murder which had taken place some time before, but of which he had not been suspected. He mentioned a spot where the property of the murdered person had been concealed by him—and the whole of the circumstances of the murder. The property was found as he had described, and the case was clearly brought home to him, chiefly by collateral evidence from his own confession. He was convicted.

When homicide is committed by a man in a state of drunkenness, this is held to be no excuse for the crime. If voluntarily induced, whatever may be its degree, it is not admitted as a ground of irresponsibility, even although the party might not have contemplated the crime when sober. Thus it would appear that when the state of drunkenness is such as that any civil act of the person would be void, he may still be held legally responsible for a crime like murder. Some judges have admitted a plea of exculpation, where the crime has been committed in a state of frenzy arising from habitual drunkenness, but even this is not general. It is important to a medical jurist to know, that in those cases where the head has sustained any physical injury, as often happens with soldiers and sailors,—drunkenness, even when existing to a slight extent, produces sometimes a fit of temporary insanity, leaving the mind clear when the drunken fit is over. The law makes no distinction between this state and ordinary drunkenness, although juries occasionally show by their verdicts, that some difference ought to be made! Hallucinations and illusions are a very common effect of drunkenness, and often lead to the commission of criminal acts.

Marc relates a case where two friends being intoxicated, the one killed the other under an illusion that he was an evil spirit. The drunkenness of the accused was held to have been voluntary; and he was condemned to ten years' imprisonment with hard labour. A case of this description was tried at the Norfolk Lent Assizes, 1840. (The Queen v. Patteson.) A man while intoxicated killed his friend, who was also intoxicated, under the illusion that he was some other person who had come to attack him. The judge made the guilt of the prisoner to rest upon whether, had he been sober, he would have perpetrated the act under a similar illusion? As he had voluntarily brought himself into a state of intoxication that was no justification. He was found guilty of manslaughter, and sentenced to two months' imprisonment.

Drunkenness, even when habitual, is not a sufficient ground for restraint or interdiction in the English law. Thus, on a commission in Nov. 1836, a jury returned that the party was of weak mind and given to habits of drunkenness, but he was not of unsound mind. On application the Lord Chancellor refused to interfere. (In re Holden.)

Delirium Tremens.—This is a disordered state of mind which proceeds from the abuse of intoxicating liquids. Habitual drunkenness appears to be the predisposing, while abstinence from drink is the immediate exciting cause. Thus, the disorder frequently does not show itself until the accustomed stimulus has been withdrawn for a certain period. It commences with tremors of the hands and restlessness; and the individual is subject to hallucinations and illusions sometimes of a horrible kind, referring to past occupations or events. The patients are often violent, and prone to commit suicide or murder, more commonly the former; hence they require close superintendence.

Persons labouring under this disorder, are incompetent to the performance of any civil act, unless the mind should clear up before death. They are not responsible for criminal acts committed while they are labouring under an attack. Acquittals have even taken place on charges of murder, where there was deliberation and an apparent motive for the act. Thus, then, although this disorder is voluntarily brought on by habitual drunkenness, the law admits it as a sufficient plea for irresponsibility; while in a case of confirmed drunkenness, it rejects the plea. Why the mere circumstance of the one being a remote consequence, should create irresponsibility, and not the other, it is difficult to explain.

Somnambulism.—It has been a contested question among medical jurists, how far a person should be held responsible for a criminal act perpetrated in that half-conscious state which exists when an individual is suddenly roused from sleep. There is no doubt here, that the mind is at this time subject to hallucinations and illusions which may be more persistent in some persons than in others; but it is difficult to suppose, unless we imagine that there is a sudden access of insanity, that an individual should not recover from his delusion, before he could perpetrate an act like murder. A remarkable case of this description, that of Bernard Schedmaizig, will be found in Marc (i. 56); and a trial involving this question occurred in England within the last few years. A pedlar who was in the habit of walking about the country, armed with a sword-stick, was awakened one evening, while lying asleep on the high road, by a man, who was accidentally passing, seizing and shaking him by the shoulders. The pedlar suddenly awoke, drew his sword and stabbed the man, who soon afterwards died. He was tried for manslaughter. His irresponsibility was strongly urged by his counsel on the ground, that he could not have been conscious of an act perpetrated in a half-waking state. This was strengthened by the opinion of the medical witness. The prisoner was, however, found guilty. Under such circumstances, it was not unlikely that an idea had arisen in the prisoner's mind that he had been attacked by robbers, and therefore stabbed the man in self-defence. (The Queen v. Milligan, Lincoln Aut. Assizes, 1836.) It is impossible to give any general opinion relative to cases of this description ; since the circumstances attending each case, will sufficiently explain how far it was likely that the crime had been committed under an illusion continuing from a state of sleep.

APPENDIX A.

TESTS AND APPARATUS REQUIRED FOR THE ANALYSIS OF POISONS.

ACIDS.—Sulphuric, Nitric, Muriatic, Oxalic, Tartaric, Acetic.

ALKALIES.—Potash, Soda, Ammonia, and their Carbonates. Calcined Carbonate of Soda.—Lime.

SALTS.—Nitrate of Barytes. Chloride of Barium.—These may be made by digesting the pure carbonate in the respective acids, and evaporating to crystallization.

Chloride of Lime. Sulphate of Lime. Nitrate of Silver. Sulphate of Iron. Ferrocyanate of Potash. Phosphate of Soda. Sulphate of Copper. Iodide of Potassium. Acetate of Lead. Bichloride of Mercury. Peroxide of Manganese. Carbonate of Barytes.

OXALATE OF AMMONIA.—Prepared by neutralizing a strong solution of Oxalic acid, with Sesquicarbonate of Ammonia, and evaporating at a low temperature to crystallization. Should the salt become acid by evaporation, add a little ammonia.

HYDROSULPHURET OF AMMONIA.—Pass sulphuretted hydrogen gas by means of a bent tube, into equal parts of a solution of pure ammonia and water, until the liquid is saturated with the gas. The solution must be preserved in a green-glass bottle. This is an important test for the detection of metallic poisons. When well made, it ought to give no precipitate with sulphate of magnesia.

SULPHURETTED HYDROGEN.—This should always be employed in the state of gas, and not dissolved in water. It may be prepared by gently heating in a retort or a flask with a bent tube, sulphuret of iron with five or six parts of diluted sulphuric acid. Care must be taken not to distil over the contents of the retort. This gas precipitates most metallic poisons, some completely, others partially. The suspected solution into which it is passed, should neither be too acid nor too alkaline.

SULPHURET OF IRON.—Heat a bar of iron to whiteness, and rub on its surface, a stick of sulphur. Collect the sulphuret which falls in a state of fusion, in a vessel of cold water, placed beneath. Dry it and keep it closely bottled. This preparation serves for the purpose of making sulphuretted hydrogen gas.

SULPHATE OF STRONTIA.—This salt in solution, is sometimes used as a test for the salts of Barytes. It may be made by digesting pure carbonate of strontia in dilute sulphuric acid. It is not very soluble in water, in consequence of which, when employed as a test, it must be used in comparatively large quantity.

PROTOCHLORIDE OF TIN.—Obtained by digesting pure tin in strong muriatic acid at a gentle heat, until no more is dissolved. A piece of metallic tin should be always kept in the solution. A useful test for Gold and Mercury.

CHLORIDE (TER) OF GOLD.—Dissolve gold foil at a gentle heat, in a mixture of one part nitric and two parts muriatic acid. The solution may afterwards be diluted with its bulk of distilled water. Used to distinguish meconic from sulphocyanic acid.

BICHLORIDE OF PLATINA.—Dissolve slips of fine platina foil or platina filings, in a mixture of one part nitric and two parts muriatic acid, brought to a boiling temperature. Platina must be added, until no further action ensues. This is a useful test for potash.

IODIC ACID.—Digest Iodine in the strongest Nitric Acid (Sp. gr. 1.52.) in a retort over a sand-bath, and repeatedly wash down with the acid, the iodine that may sublime. This process requires many hours for its completion. When there is no further action pour off the liquid, and evaporate to dryness. Iodic acid is left as a colourless solid. This test serves to distinguish morphia from the other alkaloids, and also to detect sulphuric acid in articles of clothing.

PERMURIATE (SESQUICHLORIDE) OF IRON.—Dissolve red (per) oxide of iron in muriatic acid. It may be neutralized for the purpose of a test by the addition of a small quantity of potash. Used as a test for morphia and its salts.

BLACK FLUX.—Prepared by mixing thoroughly two parts of bitartrate of potash with one part of nitrate of potash, and projecting the mixture by small portions into a red hot crucible, until complete deflagration has taken place. The grey mass obtained, should be pulverized and kept from air in a well-closed bottle. This substance is used for the reduction of the compounds of arsenic. The bitartrate itself calcined, or well-dried oxalate of lime, will answer the same purpose.

SODA FLUX.—Calcine in an earthen retort crystallized acetate of soda reduced to to a fine powder. The charred mass may be afterwards pulverized. It does not deliquesce like the black flux, and is a good reducing agent.

TEST PAPERS.—*Litmus* paper for acids.—This may be made by saturating unsized paper (free from lime) in a strong infusion of litmus (about one ounce to half a pint of boiling water) and drying it in a place entirely free from acid vapours. It should be kept from air and light. *Rose* paper for alkalies. This is made by saturating unsized paper in a strong infusion of red roses (about two ounces of petals to a pint of water) and drying the paper quickly. It should be kept from air and light.

MISCELLANEOUS ARTICLES.—Copper filings.—Thin copper-foil.—Copper-wire.—Tin filings.—Tin-foil—Zinc-foil, very thin,—Gold-leaf. Gold-foil, such as is used by dentists: in this state it serves for the detection of mercurial poisons. Reduced silver. Platina-foil—Platina wire. Platina crucible and cover.—Platina cup: These two vessels may have a capacity of about two fluid-drachms. Small glass tube (about two pounds) varying from one-fourth to one-eighth of an inch in the bore. This tube, which serves for the making of small reduction tubes, and numerous other purposes, should be very thin. Watch glasses. Test-tubes (thin)—Glass plate. Florence flasks.—Large and small retort and receiver. Filtering paper. Spirit lamp.

Charcoal powder. Animal charcoal. Alcohol. Litmus cake. Sulphate of indigo.

In pursuing an analysis, the following precautions ought to be observed: 1. All the apparatus should be perfectly clean; when metals are to be reduced, the glass tubes and fluxes should be warm and dry. 2. The solutions of the tests should be concentrated. This will give a known and definite strength which will regulate the quantity to be employed. 3. Before employing the tests, they should be tried for the ordinary impurities which they are liable to contain.

APPENDIX B.

MEDICAL WITNESSES ACT. 6 and 7 Will. 4, c. 89.

An Act to provide for the attendance and remuneration of medical witnesses at coroners' inquests.

Whereas it is expedient to provide for the attendance of medical witnesses at coroners' inquests, also remuneration for such attendance, and for the performance of post-mortem examinations at such inquests; be it therefore enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that from and after the passing of this Act, whenever upon the summoning or holding of any coroner's inquest it shall appear to the coroner that the deceased person was attended at his death or during his last illness by any legally qualified medical practitioner, it shall be lawful for the coroner to issue his order in the form marked (A.) in the schedule hereunto annexed, for the attendance of such practitioner as a witness at such inquest; and if it shall appear to the coroner that the deceased person was not attended at or immediately before his death by any legally qualified medical practitioner, it shall be lawful for the coroner to issue such order for the attendance of any legally qualified medical practitioner being at the time in actual practice in or near the place where the death has happened; and it shall be lawful for the coroner, either in his order for the attendance of medical witness, or at any time between the issuing of such order and the termination of the inquest, to direct the performance of a post-mortem examination, with or without an analysis of the contents of the stomach or intestines, by the medical witness or witnesses who may be summoned to attend at any inquest; provided that if any person shall state upon oath before the coroner that in his or her belief the death of the deceased individual was caused partly or entirely by the improper or negligent treatment of any medical practitioner or other person, such medical practitioner or other person shall not be allowed to perform or assist at the post-mortem examination of the deceased.

II. And be it further enacted, that whenever it shall appear to the greater number of the jurymen sitting at any coroner's inquest, that the cause of death has not been satisfactorily explained by the evidence of the medical practitioner or other witness or witnesses who may be examined in the first instance, such greater number of the jurymen are hereby authorized and empowered to name to the coroner in writing any other legally qualified medical practitioner or practitioners, and to require the coroner to issue his order, in the form herein-before mentioned, for the attendance of such last-mentioned medical practitioner or practitioners as a witness or witnesses, and for the performance of a post-mortem examination, with or without an analysis of the contents of the stomach or intestines, whether such an examination has been performed before or not; and if the coroner, having been thereunto required, shall refuse to issue such order, he shall be deemed guilty of a misdemeanor, and shall be punishable in like manner as if the same were a misdemeanor at common law.

III. And be it further enacted, that when any legally qualified medical practitioner has attended upon any coroner's inquest in obedience to any such order as aforesaid of the coroner, the said practitioner shall for such attendance at any inquest in *Great Britain* be entitled to receive such remuneration or fee as is mentioned in the table marked (B.) in the schedule hereunto annexed, &c.

IV. Provided nevertheless, and be it further enacted, that no order of payment shall be given, or fee or remuneration paid, to any medical practitioner for the performance of any post-mortem examination which may be instituted without the previous direction of the coroner.

V. Provided also, and be it further enacted, that when any inquest shall be holden on the body of any person who has died in any public hospital or infirmary, or in any building or place belonging thereto, or used for the reception of the patients thereof, or who has died in any county or other lunatic asylum, or in any public infirmary or other public medical institution, whether the same be supported by endowments or by voluntary subscriptions, then and in such case nothing herein contained shall be construed to entitle the medical officer whose duty it may have been to attend the deceased person as a medical officer of such institution as aforesaid to the fees or remuneration herein provided.

VI. And be it further enacted, that where any order for the attendance of any medical practitioner as aforesaid shall have been personally served upon such practitioner, or where any such order not personally served shall have been received by any medical practitioner in sufficient time for him to have obeyed such order, or where any such order has been served at the residence of any medical practitioner, and in every case where any medical practitioner has not obeyed such order, he shall for such neglect or disobedience forfeit the sum of five pounds sterling, upon complaint thereof made by the coroner or any two of the jury before any two justices having jurisdiction in the parish or place where the inquest under which the order issued was held, or in the parish where such medical practitioner resides; and such two justices are hereby required, upon such complaint, to proceed to the hearing and adjudication of such complaint, and, if such medical practitioner shall not show to the said justices a good and sufficient cause for nor having obeyed such order, to enforce the said penalty by distress aud sale of the offender's goods, as they are empowered to proceed by any Act of Parliament for any other penalty or forfeiture.

VII. And be it enacted, that nothing in this Act contained shall extend to *Scotland*.

SCHEDULE TO WHICH THIS ACT REFERS.

(A.)

Form of Summons.

Coroner's inquest at upon the body of

By virtue of this my order as coroner for you are required to appear before me and the jury at on the day of one thousand eight hundred and at of the clock, to give evidence touching the cause of death of [*and then add, when the witness is required to make or assist at a post-mortem examination*, and make or assist in making a post-mortem examination of the body with [*or* without] an analysis, *as the case may be*], and report thereon at the said inquest.

(Signed) Coroner.

To Surgeon [*or* M.D., *as the case may be.*]

(B.)

Table of Fees.

1. To every legally qualified medical practitioner for attending to give evidence under the provisions of this Act at any coroner's inquest whereat no post-mortem examination has been made by such practitioner, the fee or remuneration shall be one guinea.

2. For the making of a post-mortem examination of the body of the deceased, either with or without an analysis of the contents of the stomach or intestines, and for attending to give evidence thereon, the fee or remuneration shall be two guineas.

By a subsequent statute, 1 Vict. c. 68, sec. 2nd, the coroner is directed to advance and pay such remuneration or fee to every medical witness summoned under the provisions of the above Act, immediately after the termination of the inquest.

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